City of Portage la Prairie

Conceptual Design of the Island Park Bridge Replacement – Final Report

Prepared by:

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Project Number:

60339707

Date:

June 3, 2015

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June 3, 2015

Kelly Braden, P.Eng.
Director of Operations
City of Portage la Prairie
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Portage la Prairie, MB R1N 3S2

Dear Mr. Braden:

Project No: **60339707**
Regarding: **Conceptual Design of the Island Park Bridge Replacement – Final Report**

We are pleased to submit three hard copies and one PDF of the Conceptual Design of the Island Park Bridge Replacement – FINAL.

Please do not hesitate to call if you have any questions regarding this report.

Sincerely,
AECOM Canada Ltd.

Eric B. Loewen, P. Eng.
Senior Project Manager
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EBL:dlh
Encl.
cc:

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Executive Summary

The City of Portage la Prairie engaged AECOM to perform the conceptual design of the Island Park Bridge replacement. The conceptual design included gathering feedback from the City, multiple stakeholders, and the public through various discussions, stakeholder meetings, and a public open house.

After evaluation of three possible alternatives, the recommended replacement for the existing Island Park Bridge as a crossing to Island Park is Alternative 2, a new three lane causeway with a short-span bridge or culvert to provide clearance for recreational users of Crescent Lake. This alternative includes:

- One southbound lane and two northbound lanes. The right northbound lane would be right-turn-only at Crescent Road. The second northbound lane provides a significant improvement to traffic flow after major events on the island.
- Either 4-way stops or roundabouts at the intersections north and south of the causeway. The roundabouts provide a further improvement to the traffic flow, with an approximately $350,000 cost increase to the entire project.
- A short three or four span bridge, or a three arch culvert option. A cast-in-place box culvert has benefits for design, construction and long-term maintenance, however the public strongly supported improved aesthetics, and box culverts may be less visually appealing than other alternatives. Several bridge and arch culvert options exist and require further analysis in the preliminary design.
- An Active Transportation Pathway traveling over the bridge/culvert as opposed to a separate active transportation bridge.
- Construction will likely require staging to mitigate issues with settlement and consolidation, including differential settlement between structures and the causeway. It is anticipated that construction will extend over two winter seasons to allow for this, and to ensure continuous access to the island.
- Estimated construction cost of $6.5 million dollars.

The preliminary design should include the following:

- Site survey to confirm existing and proposed roadway, structure and causeway geometry.
- Additional geotechnical investigation and detailed design will be required to determine foundation alternatives, causeway/embankment slopes, slope stability analysis, settlement, and consolidation criteria. The unfavourable underlying soil conditions will have an impact on the type of short-span bridge or culvert option chosen.
- A review of potential impact of the widened causeway on the existing watermain.
- An expanded traffic study to include pedestrian traffic counts during major summer events to determine effects on the conceptual design alternatives. The design would include optimization and further recommendations for pedestrian crossings.
- Environmental review and applications, including determination of fish habitat in Crescent Lake.
- Review of Crescent Lake summer and winter water levels including drainage into and out of the lake, and hydraulics of the intake and outlet. This will ensure an adequate clearance envelope is provided for summer and winter recreational use.
- Preliminary structural design of culvert and bridge options in accordance with geotechnical recommendations in order to determine the optimum structure. The bridge option would likely include precast concrete girders with steel pile foundations. The culvert options would include triple steel or concrete open bottom arches on deep foundations, or triple steel pipe arches. The culvert options would likely include Mechanically Stabilized Earth (MSE) retaining walls. Differential settlement between the MSE walls and culverts will need to be addressed in the design.

1. Introduction

1.1 Background

The Island Park Bridge, built in 1929, is the single public vehicle and pedestrian access to Island Park, the Portage Industrial Exhibition Grounds, the Portage Golf Course, and several private residences across Crescent Lake. Island Park Bridge is a timber structure approximately 220 m in length. It has timber piles, pile caps, and stringers, with a timber deck, asphalt overlay, and timber posts with steel guardrail.

The traffic to and from the island consists of heavy trucks and busses, passenger vehicles, bicycles, and pedestrians. Canoes and other small watercraft use Crescent Lake, and snowmobiles travel on the ice in winter.

In the mid-1980's the north two-thirds of the bridge piles were replaced with new driven timber piles, approximately 45' in length, driven approximately 37' into the lake bed. Design and construction supervision was provided by AECOM (formerly Reid Crowther). The wooden decking and asphalt pavement were replaced over the entire bridge. The southerly one-third (1930's installation) of the bridge piles and pile cap beams were untouched.

In recent years, some remedial work has been done on the southerly one-third of the bridge but no long term upgrades have been completed. Many of the piles, pile caps, and stringers are rotting and in poor condition and will require replacement in the near future.

The bridge is load restricted and heavier vehicles are currently required to use the temporary single lane causeway to the west of the bridge. The south end of the causeway encroaches on private land. A cantilevered pedestrian walkway on the bridge has been removed and replaced with a walkway on the causeway. Recreational vehicles (boats and snowmobiles) are currently prevented from crossing under the bridge due to the causeway and small diameter culvert.

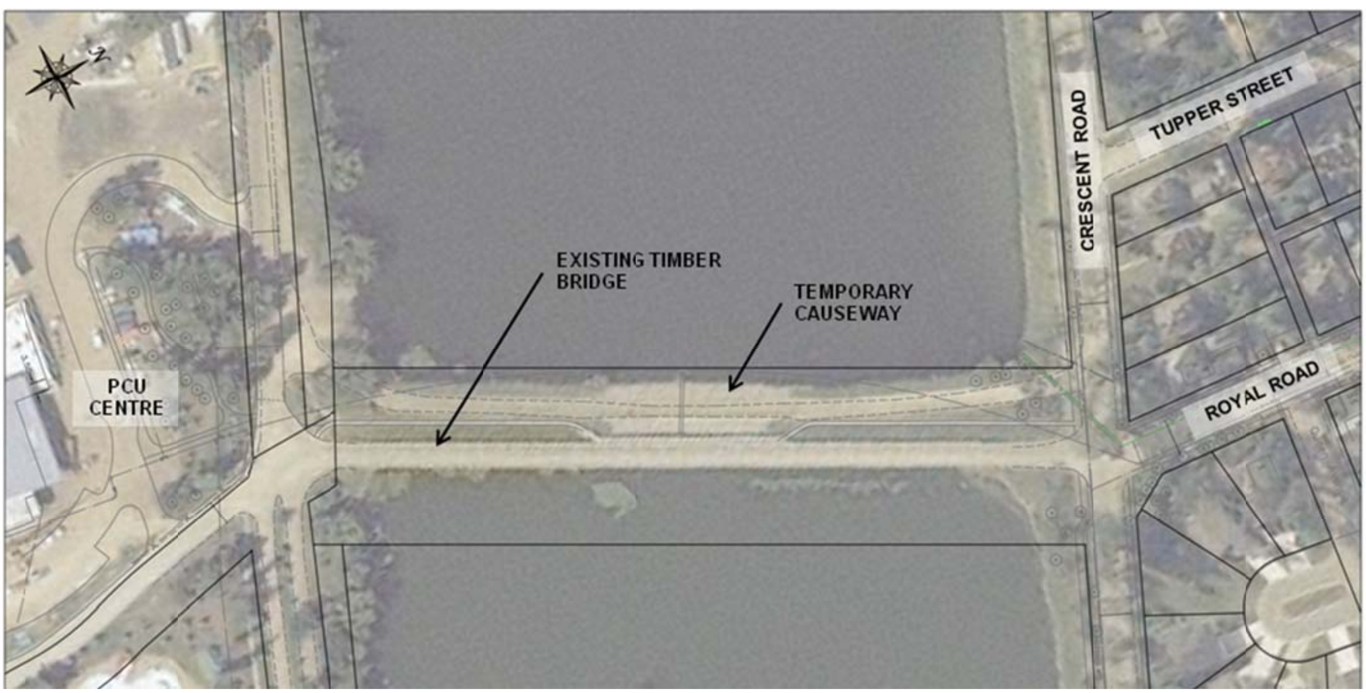


Figure 1: Existing Configuration

1.2 Purpose

The purpose of this report is to supply the City with a conceptual design recommendation and cost estimate for the replacement of Island Park Bridge. The goal is to find the most cost effective solution that also meets the needs of the community, and accommodates various modes of travel, while providing an aesthetically pleasing result.

1.3 Alternatives

Three alternatives were considered for the conceptual design of the Island Park Bridge replacement. Each alternative includes provisions for minimum two lane vehicle access across Crescent Lake, accommodating highway truck loading; a pedestrian walkway; cyclist access; bridging to allow for water flow from west to east and snowmobile, cross-country skier, skater, and small boat passage; lighting; and landscaping. Each alternative also includes optional intersection designs including conventional intersections and roundabouts at each end of the bridge.

Additional profile and section views can be viewed in Appendix B.

1.3.1 Alternative 1: New Bridge

This alternative consists of a full length bridge replacement that will accommodate highway truck traffic and light vehicles, with a short single span steel pedestrian/cyclist bridge on the existing west causeway as follows:

- The bridge would likely be a precast prestressed concrete box girder bridge with steel pile bents, concrete curbs, and steel guardrails.
- The bridge would accommodate two lanes of traffic.
- Four-way stop intersections similar to the existing or single-lane roundabouts could be used at either end of the bridge.
- This alternative would make use of the existing causeway for active transportation users.
- The active transportation bridge would likely be a single span steel truss structure.
- Clearance below both the vehicular bridge and the pedestrian/cyclist bridge would accommodate the crossing of small watercrafts in the summer and snowmobiles, cross-country skiers, and skaters in the winter.

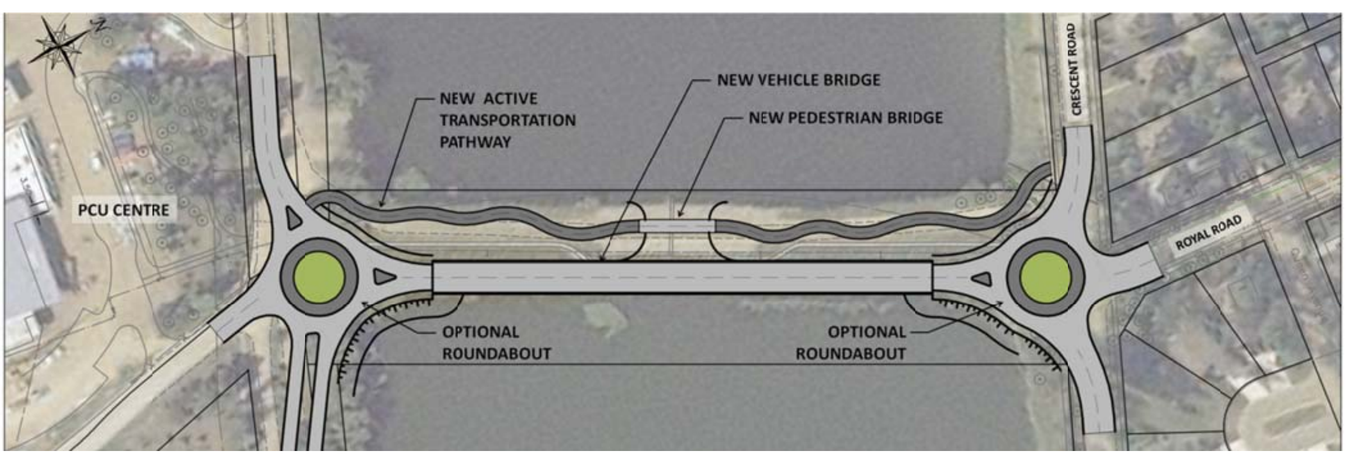


Figure 2: Alternative 1 – New Bridge

1.3.2 Alternative 2: New Three Lane Causeway

The second alternative is to replace the existing timber bridge with a three lane causeway and a short span bridge or culvert to accommodate heavy and light vehicle traffic, pedestrians, and cyclists as follows:

- This alternative would accommodate three lanes of traffic, two lanes in the northbound direction and one lane in the southbound direction.
- The right northbound lane would be a right-turn lane only at Crescent Road.
- The type of short-span vehicular bridge could be one of the following:
    - i. Three or four span prestressed precast concrete girder bridge with steel piles.
    - ii. Triple barrel steel or concrete open bottom arch culvert.
    - iii. Triple barrel steel pipe arch culvert.
    - iv. Triple barrel concrete box culvert.
- The active transportation path would either cross along the bridge or would have a separate pedestrian structure.
- Four-way stop intersections similar to the existing or single-lane roundabouts could be used at either end of the bridge.
- Clearance below both the vehicular bridge and the pedestrian/cyclist bridge would accommodate the crossing of small watercrafts in the summer and snowmobiles, cross-country skiers, and skaters in the winter.

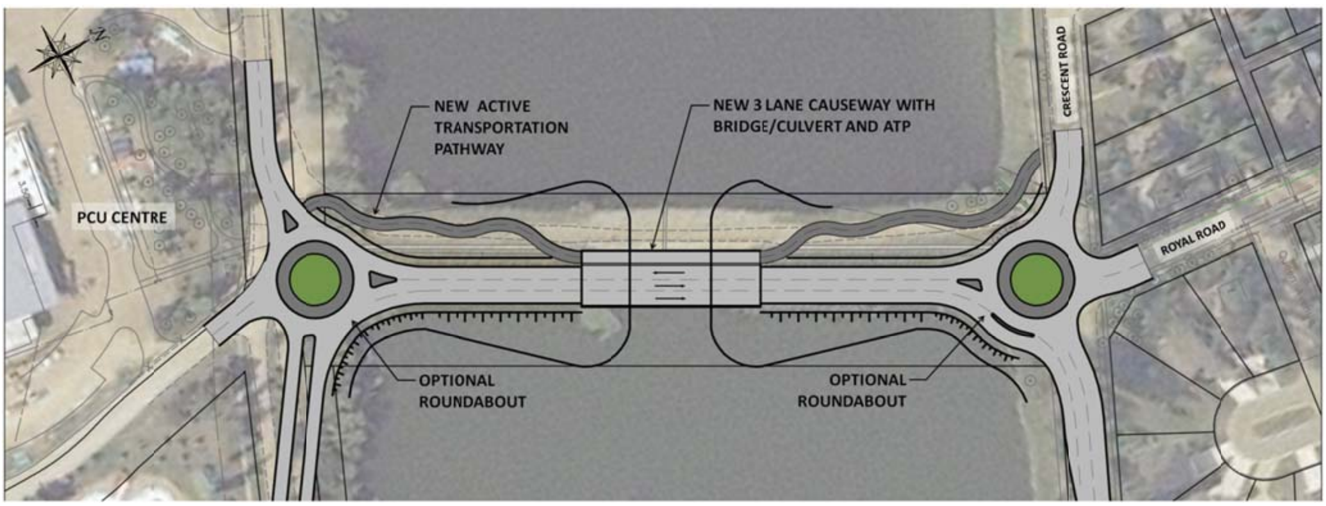


Figure 3: Alternative 2 – New Three Lane Causeway with Roundabouts

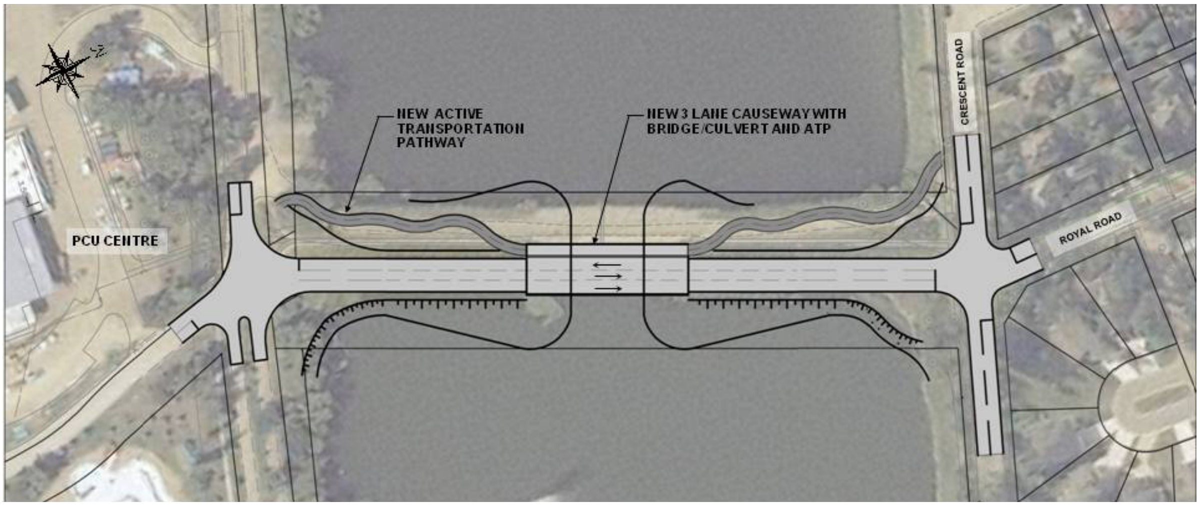


Figure 4: Alternative 2 – New Three Lane Causeway with 4-Way Intersections

1.3.3 Alternative 3: Tupper Alignment

This alternative would involve replacing the existing bridge and constructing a new causeway with a short span bridge or culvert in alignment with Tupper Street. This could also include a separate short single-span steel truss pedestrian/cyclist bridge on the existing west causeway. The third alternative would include the following:

- This alternative would accommodate three lanes of traffic, two lanes in the northbound direction and one lane in the southbound direction.
- The right northbound lane would be a right-turn lane only at Crescent Road.
- The type of short-span vehicular bridge could be one of the following:
  - i. Three or four span prestressed precast concrete girder bridge with steel piles.
  - ii. Triple barrel steel or concrete open bottom arch culvert.
  - iii. Triple barrel steel pipe arch culvert.
  - iv. Triple barrel concrete box culvert.
- The active transportation path would either cross along the bridge or would have a separate pedestrian structure along the existing temporary causeway.
- The embankment fill between the existing causeway and the new causeway along Tupper Street would create a pond. Alternatively, this area could be filled in to create a park.
- Four-way stop intersections similar to the existing or single-lane roundabouts could be used at either end of the bridge.
- Clearance below both the vehicular bridge and the pedestrian/cyclist bridge would accommodate the crossing of small watercrafts in the summer and snowmobiles, cross-country skiers, and skaters in the winter.

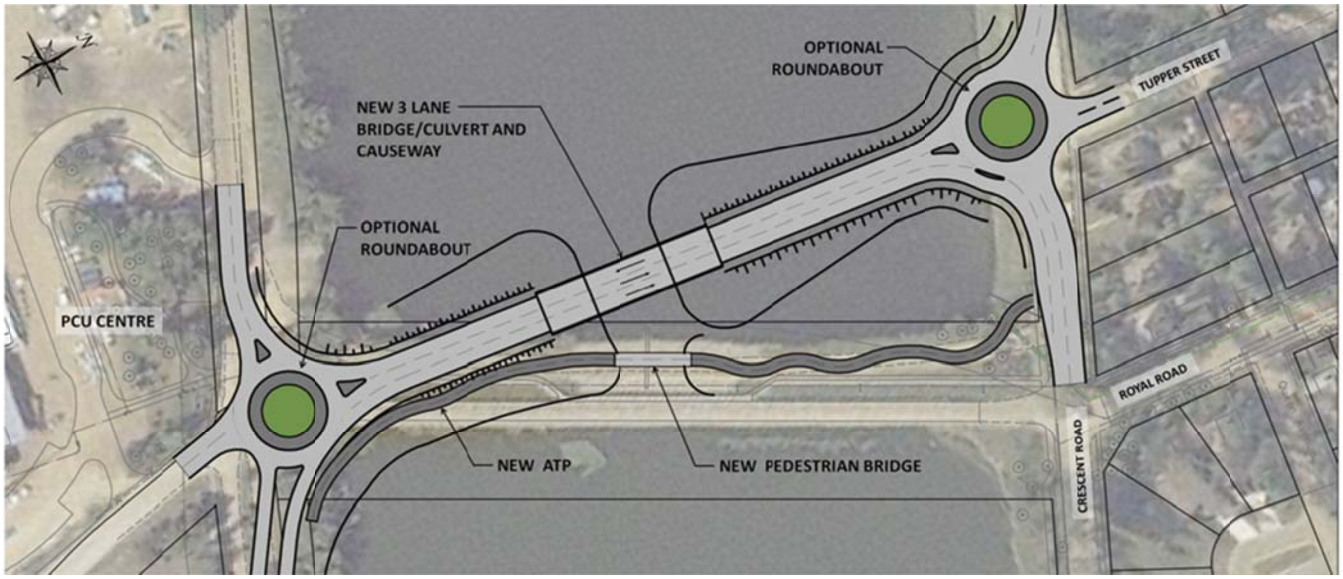


Figure 5: Alternative 3 – Tupper Alignment

1.3.4 Other

A fourth alternative was initially proposed in the Request for Proposal (RFP). This option was to include repairing the existing timber bridge and to construct a two lane heavy load causeway with a short span bridge or culvert on the east side of the existing bridge. The pedestrians would cross along the existing west causeway with a new short span pedestrian/cyclist bridge. However, this alternative did not meet current safety standards and would cause substandard intersection geometry on both ends of the structure. It would lead to unsafe weave conditions and the City would still be left with ongoing bridge maintenance costs. For these reasons, the fourth alternative was not pursued any further, and will not be discussed further in this report.

2. Evaluation

The three alternatives discussed in Section 1.3 were compared and evaluated in order to determine which alternative would be best suited for the replacement of Island Park Bridge. The evaluation considered many factors including the City's vision, the stakeholders' opinions, the public's comments and the conceptual engineering analysis performed by AECOM. Engineering design considerations were analyzed to ensure the proposed alternatives were feasible, economical, and aligned with the City's goals for the project.

2.1 Level of Service, Traffic Flow, and Functionality for Pedestrians and Cyclists

This traffic operational review provides an assessment of intersection operations at the north and south ends of the Island Park Bridge. A micro-simulation analysis using Trafficware Synchro Version 9.0 was conducted using event peak traffic (Portage Terriers playoff hockey game Sunday, March 15th, 2015), to review level of service (delay), intersection capacity and vehicle queue along the access corridor. Detailed analysis results of the Trafficware Synchro can be found in Appendix A.

A Portage Terriers playoff hockey game was held on March 15, 2015, and a traffic study was conducted at the beginning and end of this event. The intent of the use of the March 15, 2015 event traffic volumes was to model the traffic flow during a time when intersection congestion would be expected all of the vehicles are released from the PCU Center at once. It is recognized that different events such as Canada Day celebrations or other Island Park events would not necessarily result in the same Level of Service for the affected intersections. It should also be noted that the PCU centre was at approximately 50% capacity for the event. It should also be noted that the data collected from the traffic study was altered to model the peak 10 minute interval during which the traffic was at its worst. The Level of Service (LOS) is therefore not a representation of a typical hourly event at these intersections.

The intersections modeled and analysed as part of this study are based on Alternative 2 and consist of: the existing condition; a three lane causeway with unsignalized intersections; and a three lane causeway with roundabouts. The intersections analyzed include Royal Road at Crescent Road East on the north end and Royal Road at George Hill Drive on the south end.

For roadway geometry and lane configurations, AutoCAD drawings and ortho-corrected aerial imagery was imported and utilized as the model background.

Intersection turning movement and pedestrian counts were undertaken by AECOM on March 15, 2015 for the event at the PCU Centre.

For this analysis the calculation of the Level of Service (LOS) for the intersection is based on the Highway Capacity Manual determination of the All Way Stop Condition (AWSC) as the average delay per vehicle and is shown in Table 2-1.

Table 2-1: Level of Service AWSC

Level of Service (LOS)	Delay per Vehicle (s)
A	≤ 10
B	>10 ≤ 15
C	>15 ≤ 25
D	>25 ≤ 35
E	>35 ≤ 50
F	≥ 50

Measures of Effectiveness (MOEs) such as Level of Service (LOS), Capacity or Volume per Capacity (V/C) and vehicle Queue are summarized by intersection based on the peak hour analyzed. Intersection LOS ranges by definition from LOS A, which provides the highest level of operational service to LOS F, which constitutes failure of the intersection.

A LOS D is commonly considered the limit of acceptable operation and significant delays in traffic can occur below this level. Under certain circumstances, a LOS E is acceptable for left turn movements only in an attempt to provide improved level of service for opposing through traffic.

In this analysis three intersection and lane configurations were analysed for the north and south intersections and the LOS, Capacity and 95th percentile vehicle Queues were calculated for the critical lanes and are presented in Table 2-2 and Table 2-3 following.

Table 2-2: Royal Road and Crescent Road East

Lane and Intersection Geometry	Level of Service (LOS)	Capacity (V/C)	95th Percentile Queue (m) # of vehicles	
All Way Stop Condition (AWSC) – 2 Lanes	F (intersection delay of 93.5 s/veh)	116 % (critical lane - NB)	255 m 33 vehicles (critical lane – NB)	
AWSC – 3 Lanes	D (intersection delay of 30.4 s/veh)	90% (critical lane – NB)	55 m 7 vehicles (critical lane – NBL)	28 m 4 vehicles (critical lane – NBR)
Roundabout – 3 Lanes with right Turn Cut-off (RTCO).	A Intersection delay of 9.3 s/veh	61% (critical lane – NBL)	4 m 1 vehicle (critical lane – NBL)	2 m 1 vehicle (critical lane – NBR)

NB – Northbound
NBL – Northbound Left
NBR – Northbound Right
V/C – Volume per Capacity

Table 2-3: Royal Road and George Hill Drive

Lane and Intersection Geometry	Level of Service (LOS)	Capacity (V/C)	95th Percentile Queue (m) # of vehicles	
All Way Stop Condition (AWSC) – 2 Lanes	D (intersection delay of 32.7 s/veh)	86 % (critical lane - EBL)	73 m 10 vehicles (critical lane - EBL)	66 m 9 vehicles (critical lane - NBT)
AWSC – 3 Lanes	D (intersection delay of 32.7 s/veh)	86% (critical lane – EBL)	57 m 7 vehicles (critical lane – EBL)	57 m 7 vehicles (critical lane – NBT)
Roundabout – 3 Lanes With RTCO	C (intersection delay of 15.1 s/veh)	51% (critical lane – EBL)	3 m 1 vehicle (critical lane – EBL)	6 m 1 vehicle (critical lane – NBT)

NB – Northbound
NBL – Northbound Left
NBR – Northbound Right
V/C – Volume per Capacity

2.1.1 Traffic Analysis – AWSC 2 Lanes

Note that for the hockey playoff event on March 15, 2015 pedestrian counts were recorded and entered into the micro-simulation at 15 pedestrians per hour. It is recognized that in the summer months other events would be expected to have substantially higher pedestrian counts since more people would access Island Park by walking and other non-vehicular means. Notwithstanding whether the intersection is a roundabout or a stop controlled intersection, they would both be significantly affected by at-grade pedestrian conflicts based on anecdotal pedestrian traffic numbers provided by the City of Portage la Prairie for major summer events.

Based on the analysis the existing condition has identified the north intersection to be over capacity and operating during event traffic at a Level of Service F. Vehicle queues have been modelled such that northbound traffic backs up the entire length of the causeway and affects the operation of the south intersection.

With the level of congestion on the causeway it is difficult to obtain a clear picture of the operation of the south intersection however the model indicates that the intersection operates at a Level of Service D with the capacity of the critical Eastbound Left (EBL) lane of 86%. With the average length of vehicle calculated at 7.62m including the space between vehicles this shows a queue of approximately ten (10) vehicles in the critical EBL lane and nine (9) vehicles in the Northbound Through (NBT) lane.

2.1.2 Traffic Analysis – AWSC 3 Lanes

By adding an additional lane on the causeway the Level of Service improves to LOS D for the north intersection and remains at LOS D for the south intersection. They both remain near full capacity however the vehicle queues in the northbound left and through lanes on the north intersection has been reduced to 1/5th of the existing condition to approximately seven (7) vehicles.

On the south intersection the LOS and capacity remain unchanged with the addition of the third lane however there is some added slight improvement in terms of queue lengths which improve from ten (10) vehicles to seven (7) for the Eastbound lane.

2.1.3 Traffic Analysis – Roundabouts with Three Lanes and a Right Turn Cut-off (RTCO) at the North Intersection

Once the intersections are modelled as roundabouts significant improvement is observed in the model with the level of service improving to an LOS of A on the north intersection and a LOS C on the south intersection. Vehicle queues are eliminated and capacity has been doubled.

2.1.4 Truck Movements through Roundabout

The conceptual design of roundabouts indicates that the truck traffic from Mayfair Farms can be accommodated including B-Train (double trailer) configurations. However this would require a low lip curb and inner ring of pavement/pavers to allow larger trucks to cut over the curb.

The truck turning movements through the roundabouts can be seen detailed in Appendix C. Based on these diagrams, the truck movements can be accommodated, however further refinements will be required in the preliminary and detailed design.

2.2 Structural Options

This section of the report discusses the various bridge options available for the project.

2.2.1 Full Length Bridge

Alternative 1 includes a new, full length, multi-span bridge to cross Crescent Lake. A full length bridge will generally be less economical than a causeway option and therefore only a two lane bridge was considered. A three lane bridge is feasible but highly uneconomical, and would drive up the cost of Alternative 1 significantly.

Several bridge options were considered for this crossing including steel, timber, and concrete girders. The most efficient full length bridge option would likely be a multi-span precast prestressed concrete box girder with steel pile bents, concrete curbs, and steel guardrails. A standard MIT precast prestressed concrete channel (PPCC) girder bridge was considered initially to reduce cost. However it is not considered suitable for this location due to the urban location, application of road salts, and inappropriate drainage details of a PPCC bridge for an urban location. Due to the shallow nature of Crescent Lake and the poor underlying soils, it would be more economical to have a larger number of short spans as opposed to a smaller number of longer spans.

The full length bridge in Alternative 1 would include 2 vehicular lanes, each 3.7 m wide, and a shy distance of 1.2 m on both sides. This shy distance could potentially allow cyclists to share the roadway with vehicular traffic, while also providing a buffer between the roadway and the curb.

2.2.2 Short Span Bridge

Alternatives 2 and 3 both include a short-span vehicular bridge or culvert to allow traffic to cross the causeway while allowing clearance below for recreational users. Alternative 2 also provides the option of having the Active Transportation Path (ATP) cross along the short-span bridge or culvert in order to minimize costs.

The short span bridge in Alternatives 2 and 3 would include 3 vehicular lanes, each 3.7 m wide, and a shy distance of 1.4 m on both sides. This shy distance could potentially allow cyclists to share the roadway with vehicular traffic, while also providing a buffer between the roadway and the curb.

The City of Portage la Prairie has requested that small watercrafts be able to travel under the proposed structure during the summer months and that snowmobiles, cross-country skiers, and skaters can cross under in the winter. All alternatives have been designed to accommodate the clearance required for all of these recreational users. The clearance box assumed is a minimum of 4.2 m wide and 2.5 m high based on similar designs in Manitoba and other jurisdictions. Specifically, the structure design will provide separate pathways for snowmobilers, cross-country skiers, and skaters. A triple barrel culvert or a four span bridge structure would allow all users to be safely separated below the structure.

The four types of short-span bridges that were evaluated are as follows:

1. A short span bridge structure including the following:

   - Three or four spans, approximately 12 m in length each.
   - Prestressed precast concrete girders.
   - Steel piles.
   - Concrete curbs.
   - Steel guardrails and approach guardrails.

Settlement of the approach foundations would be an issue requiring mitigation.

Figure 6: Sample Prestressed Precast Concrete Girder Bridge

2. Open bottom arch culvert including the following:

- Three barrels, approximately 5.0 m in width and 2.5 m of clearance height above the waterline.
- Steel or concrete culvert.
- Likely requires piled foundation.
- Mechanically Stabilized Earth (MSE) walls over culverts and on approaches.
- Possible use of light weight fill to mitigate settlement.
- Textured or coloured precast panels to improve aesthetics.

Differential settlement between the piled foundation and approach MSE walls would be an issue.

Figure 7: Sample Open Bottom Arch Culvert

3. Pipe arch culvert including the following:

- Three barrels.
- Steel pipe arch culvert.
- MSE walls over culverts and on approaches.
- Possible use of light weight fill to mitigate settlement.
- Textured or coloured precast panels to improve aesthetics.

This option, if suitable geotechnically, would mitigate the differential settlement.

Figure 8: Sample Pipe Arch Culvert

4. Box culvert including the following:

- Three barrels.
- Concrete box culvert with shallow arch.
- Cast-in-place wingwalls, or MSE walls if required.
- Possible use of light weight fill to mitigate settlement.
- A façade or specially formed concrete to improve aesthetics.

Figure 9: Sample Box Culvert

2.2.3 Active Transportation Bridge

The conceptual design of Alternative 1 includes the use of a short separated active transportation bridge parallel to the vehicular bridge. Alternatives 2 and 3 also have the option of using a separated active transportation bridge for the crossing over the waterway.

The active transportation bridge would likely be a single span steel truss structure with a concrete deck. The width of the active transportation bridge would remain the same width as the ATP at approximately 4.0 m. It is anticipated that the clear span of the active transportation bridge would be approximately 25 m.

Figure 10: Sample Steel Truss Active Transportation Bridge

2.3 Optional Items

Several optional sub-items have been discussed in the previous sections of this report. In order to provide a cost estimate for each alternative, only one of the sub-options is used in the total cost estimates in Section 2.12. However, the following table provides a summary of the different sub-options.

Table 2-4: Optional Items

Options
Intersections
Roundabouts (selected for costing)
4-Way Stop
Short-Span Bridge
Prestressed precast concrete girder bridge
Steel or concrete open bottom arch culvert (selected for costing)
Steel pipe arch culvert
Concrete box culvert
Pedestrian Crossing
Separate Active Transportation Bridge
ATP on vehicular bridge or culvert (selected for costing)

For Alternative 2, it is estimated that the cost increase from 4-way stop to roundabouts would be approximately $350,000.

2.4 Right-of-Way and Property Impacts

The right-of-way and the property impacts on the surrounding residences were considered in the conceptual design of Island Park Bridge.

Alternatives 1 and 2 do not alter the existing alignment of the Crescent Lake Crossing and would therefore have minimal impacts on the property owners surrounding the bridge. The change in alignment with Tupper Street for Alternative 3 would have a greater impact on the surrounding properties. Residents along Tupper Street would see an increase in traffic flow along their street, and the residences at the corner of Crescent Road and Tupper Street would be located at the crossing to Island Park. Additionally, the residents along Crescent Lake between Royal Road South and Tupper Street would possibly lose their lake front views due to the extension of the causeway and a possible pond (or filled in park area) between the newly aligned causeway and the existing causeway.

Another consideration for the right-of-way and property impacts is in the use of roundabouts instead of the existing 4-way stop intersections. The intersections in all alternatives have been conceptually designed to avoid encroaching on existing residential property lines, and therefore the roundabouts would encroach onto the footprint of Crescent Lake.

2.5 Utility Impacts

2.5.1 Shallow Utilities

The shallow utilities in the project zone include the following:

- Gas line (North intersection only).
- MTS line (underground at North intersection and aerial at South intersections and crossing along Island Park Bridge).
- Manitoba Hydro power line – aerial (North and South intersections and crossing along Island Park Bridge).
- Street lighting aerial along causeways.

The aerial Manitoba Hydro power line, MTS line and street lighting line should be relocated underground in order to improve the aesthetics of the Island Park Bridge crossing. This can be accommodated with all of the alternatives. Conduits over structure would be provided in the bridge curb or electrical lines would be located in the fill over culverts.

2.5.2 Deep Utilities

The deep utilities include the following:

- 300 mm HDPE Watermain (North and South intersections and crossing along Island Park Bridge).
- 100 mm HDPE Watermain (South intersection only).
- 1200 mm Land Drainage Sewer (North intersection only).

There is a 300 mm HDPE watermain on the west side of the temporary causeway that runs parallel to Island Park Bridge. This watermain, designed by AECOM in 2009, was installed by directional drilling. The new Tupper Street alignment of Alternative 3 would cross over this existing watermain and would require further analysis to determine the impact on this deep utility. It may be necessary to relocate the watermain if Alternative 3 is chosen. This relocation has been reflected in the costs.

2.6 Environmental Impact

2.6.1 Existing Environment

A search of publicly available documents and databases did not result in any fisheries information for Crescent Lake (Milani 2013). Upon requesting additional information on the lake, representatives from the City indicated that:

- There are no large bodied fish and that only "minnows" have been observed.
- Water is pumped into the lake from the Assiniboine River but small fish may get in even though the pump has a screen on the intake.
- The lake is shallow but does not freeze to bottom.
- Stocking was once attempted but none of the fish survived the winter.

The City indicated that there is a dam structure at the inlet that allows the City to regulate the water levels in Crescent Lake.

2.6.2 Permitting Requirements

Under the assumption that the lake undergoes annual winter kill (anoxic conditions in small volumes of water under ice result in fish mortality) and has no connectivity to fish bearing waterbodies, Crescent Lake might be considered an artificial waterbody which does not support fish and therefore does not require DFO review. If the City is confident in their observations and statements as included above a Request for Review to DFO is not required. Should the City wish to err on the side of caution, AECOM biologists can collect fish and fish habitat information on Crescent Lake in spring after ice off which can then guide decisions on regulatory requirements.

However, if there is doubt in these statements it is recommended that a site visit by biologists with fishing effort is conducted to determine the presence of a sustainable fish population in Crescent Lake. It should be noted that "minnows" may in fact be juvenile large bodied fish to an untrained eye. If Crescent Lake supports sport fish then a fish and fish habitat assessment should be conducted to determine if the population and community are sustainable and if installation of a causeway and bridge will affect their habitat. An environmental biologist can conduct a fish and fish habitat assessment at the site during open water conditions and prepare a report compiling information obtained. The Fish and Fish Habitat Report will summarize the existing aquatic environment based on the observed site conditions and the data collected during the desktop exercise. Once an Alternative is selected and preliminary design components are developed, a Request for Review to DFO can be prepared and submitted if required. The Request for Review is intended to provide DFO with enough information to determine if "serious harm" to fish will occur. "Serious harm" is identified in the Fisheries Act as the death of fish; a permanent alteration to fish habitat; and/or the destruction of fish habitat.

Details for each Alternative permitting requirements assumes that Crescent Lake is considered a waterbody.

2.6.2.1 Alternative 1 – New Bridge

According to the DFO Self Assessment Tool repairs of existing bridges do not require DFO review if there is no temporary or permanent fill placed below the high water mark and there is no increase in the existing footprint. Alternative 1 proposes to utilize and expand the existing causeway and replace the bridge. If proper mitigation measures are utilized, such as turbidity curtains and respecting timing windows, then the impact of construction is minimal. Any bank stabilization and causeway maintenance components of the project should also be considered and included in the project design.

A Request for Review should be submitted to DFO to allow their review of the project. This document will include a summary of the existing environment, the design and proposed mitigation measures.

2.6.2.2 Alternative 2 – Three Lane Causeway

According to the DFO Self Assessment Tool, removal of a bridge structure does not require review, but infill of potential fish habitat needs to be assessed. If Crescent Lake is deemed fish bearing the causeway construction will potentially result in destruction of fish habitat. The loss of fish habitat may require a *Fisheries Act Authorization*.

A Request for Review is recommended to provide DFO with information about available habitat under the bridge and if there is any net loss with the installation of the causeway in its place. The Request for Review will also include design plans and proposed mitigation methods.

2.6.2.3 Alternative 3 – Tupper Alignment

Installation of a new causeway will require infill below the high water mark. If Crescent Lake is deemed fish bearing the causeway construction will potentially result in destruction of fish habitat. The loss of fish habitat may require a *Fisheries Act Authorization*.

A Request for Review is recommended to provide DFO with information about available habitat at the proposed causeway location, design plans, and proposed mitigation methods.

2.7 Geotechnical Considerations

The available information was reviewed from the geotechnical investigation completed by The National Testing Laboratories Limited in 2009 to assess the directional drilling for the watermain at the close proximity of the Island Park Bridge. The existing information indicated a poor subsurface condition specifically at the top 4 m below lakebed; therefore further geotechnical investigations is recommended to support the preliminary and detailed design phases, garner a better understanding of the underlying soil conditions, and ensure adequate geotechnical design for the bridge or culvert foundation and approach embankments or causeway.

The full length bridge in Alternative 1 would require steel piles driven to adequate depth below lakebed. Pile foundations can generally be accommodated to overcome poor ground conditions through load transfer to proper bearing stratum.

For Alternatives 2 and 3, the short span bridge or culvert would need to be designed with the soil conditions in mind. Steel piles would likely provide adequate geotechnical capacity to support the foundation for the four-span bridge, open bottom arch culvert, and/or box culvert options. A steel pipe arch option (no deep foundations) may or may not be feasible.

It is also important to consider the differential settlement between the culvert barrels and the surrounding MSE walls and embankments. Soil stabilization may be required underneath the MSE walls and/or use of light weight fill material in order to minimize differential settlement. Staged construction to mitigate settlement and consolidation issues is discussed in Section 2.9.

The conceptual design for the causeway in the above mentioned alternatives assumed a side slope of 4 horizontal to 1 vertical (4H:1V) for geotechnical slope stability. Detailed stability analysis based on additional geotechnical investigation is recommended to confirm the assumed side slope and to ensure adequate factor of safety against slope instability.

2.8 Historic and Archaeological Impact

The existing timber bridge was built in 1929 and therefore is over 85 years old. Based on discussions with the City of Portage la Prairie and with the District Heritage Advisory Committee, it was concluded that the bridge does not represent a significant historical site. It was also concluded that the bridge is not a significant example of period bridge building. The existing timber bridge was built to be a functional crossing to Island Park, and the structure has likely now outlived its design life. Based on these findings and on the public's feedback as discussed in Section 2.13.2, it was determined that there is little historic or archaeological need to preserve the existing timber bridge. (It is recognized that some residents will disagree with this statement.)

Alternative 3 would change the historical alignment with Royal Road to Tupper Street. However the historical alignment was not perceived to be of much importance to the City, the District Heritage Advisory Committee, or the public.

2.9 Construction Staging, Constructability, and Schedule

It is understood that the City will not allow the loss of public access to Island Park for any duration during construction. Since the Island Park Bridge and causeway are the only public access to the area, it is imperative that residents of the island and the public have uninterrupted access to Island Park, including for the use of emergency vehicles.

It is recommended to make use of existing infrastructure during construction in order to minimize temporary detour costs. If necessary, a temporary ice road may be used during the winter months to provide access to the island during construction on the existing alignment.

2.9.1 Alternative 1: New Bridge

The New Bridge alternative will allow construction access from the existing causeway during the demolition of the existing timber structure, and subsequent installation of a new full length bridge. The existing causeway would also accommodate traffic during construction. Once the new full length bridge is completed, expansion can begin on the existing causeway to complete the pedestrian crossing portion of the project. Therefore, the construction staging for Alternative 1 is relatively straight-forward and it is anticipated that the construction could be completed during a single winter/summer season.

2.9.2 Alternative 2: Three Lane Causeway

During construction of Alternative 2, it is recommended to use the existing causeway for a temporary detour during demolition of the existing timber bridge. Following the removal of the bridge, the new causeway fill can begin to be installed. However, due to the expanded footprint of the causeway, the new causeway would actually cover the existing causeway, and would therefore need to be completed in stages. Allowing consolidation of the underlying soils and settlement of the embankment fill over the course of a year may improve the performance of the underlying soil. This may reduce costs for foundations and minimize differential settlement. Therefore, it is recommended that Alternative 2 be completed over two winter and one summer season. The use of a temporary ice road may be required at some point during construction. For landscaping plans and a section view of the Three Lane Causeway alternative, refer to Section 2.10.

2.9.3 Alternative 3: Tupper Alignment

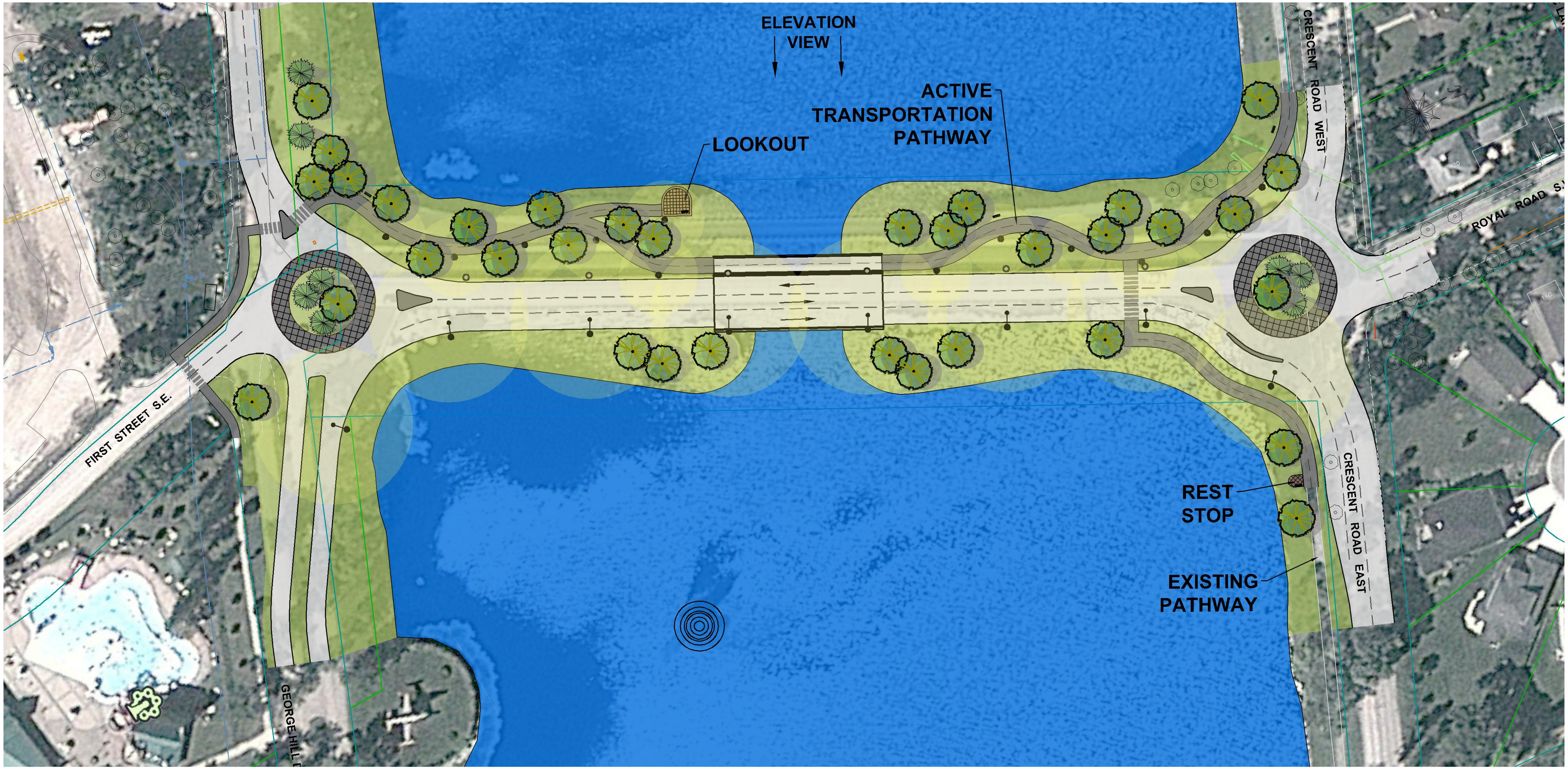
Since the third alternative does not overlap the existing alignment for the majority of the crossing, it is feasible to use the existing bridge and causeway during construction of the new Tupper Street causeway. A temporary detour may be required at the south intersection where the alignments will overlap. Once the Tupper alignment is completed, the next stage would be to remove the existing timber bridge and to expand the causeway for pedestrian use. It is anticipated that Alternative 3 would be completed in two summer and one winter season to accommodate consolidation of the underlying soils and settlement of the embankment fill. Relocation of the existing watermain, if required, would also need to be added to the schedule.

2.10 Landscaping / Aesthetics

The landscape architectural design was undertaken to address functional and aesthetic requirements of the project. The functional aspects include: layout of the Active Transportation Pathway along the roadway and bridge and the connection and integration of the Active Transportation Pathway to existing pedestrian and bicycle pathways surrounding the project. The aesthetics through the planting design creates a ‘park-like’ setting and further enhances the character of Portage la Prairie through beautification and in addition it addresses the following:

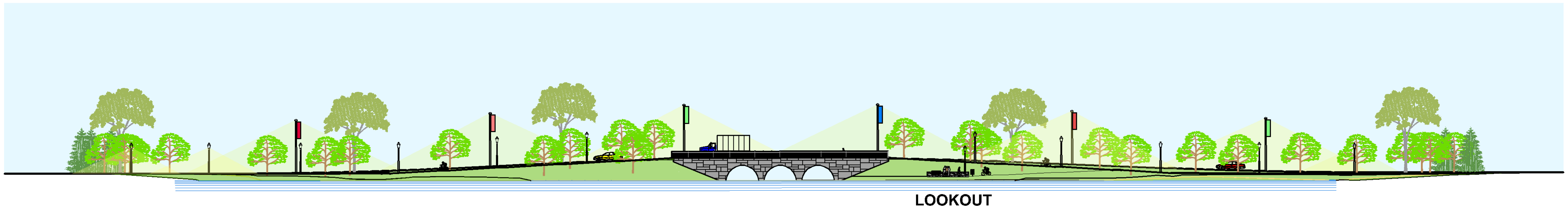
- Connecting existing multi-use pathways and sidewalks along Crescent Road to the sidewalks and trails on Island Park.
- Alignment of the proposed Active Transportation Pathway.
- Diversity of plant material using a broad mix of tree and shrub species hardy to the prairie region.
- Durable, aesthetically pleasing hard surface materials used for the lookout, rest stop and other areas of paving.
- Bridge structure and retaining wall aesthetics.

The proposed landscaping plans and section view can be found on the following pages.

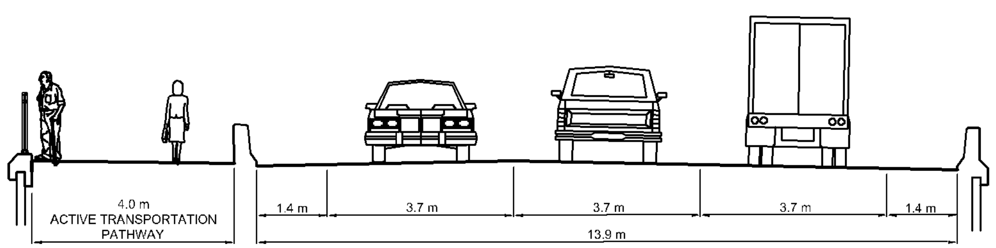


AECOM

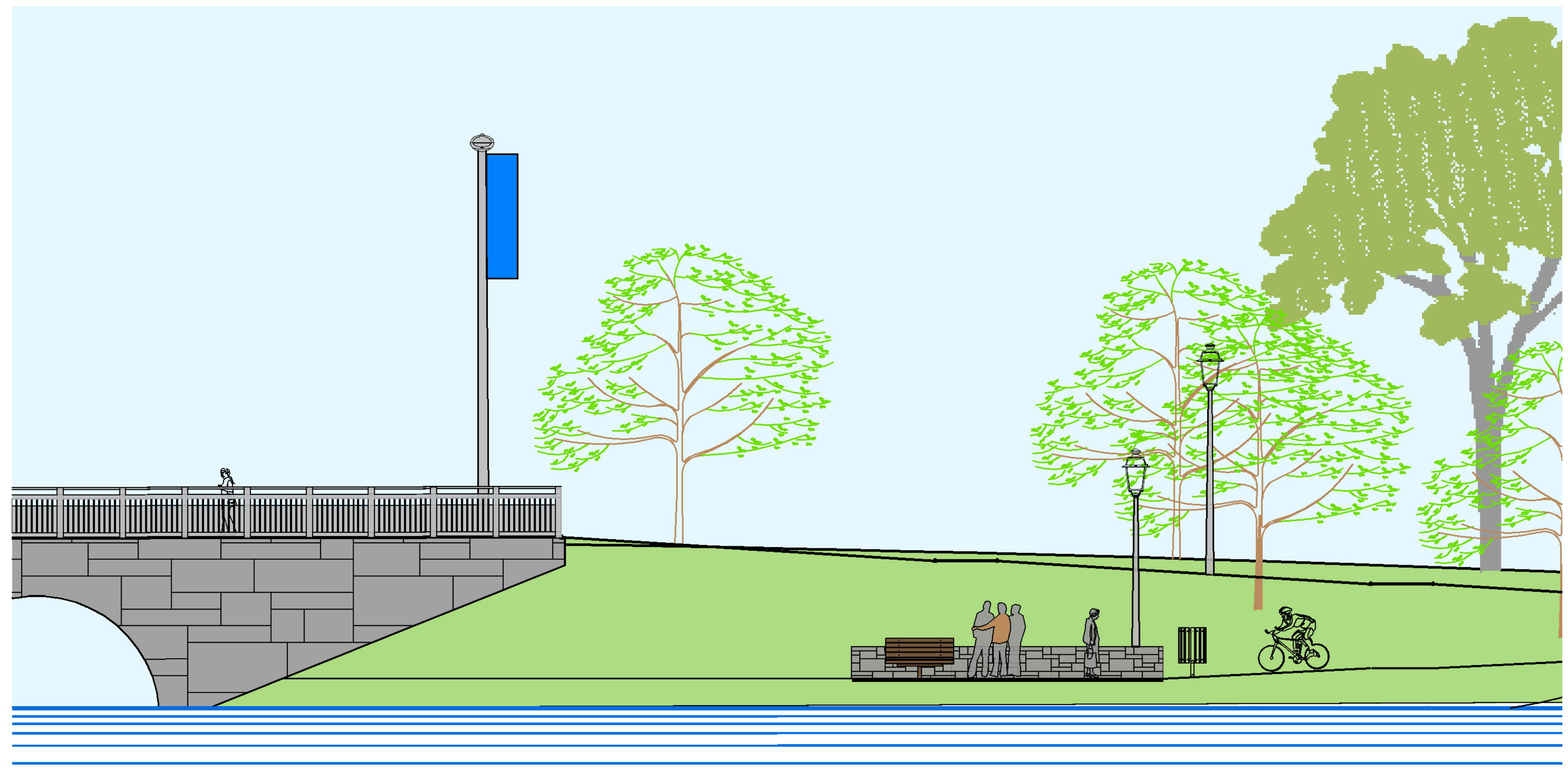
LANDSCAPING
PLAN VIEW OF ALTERNATIVE 2
Figure 11



Elevation



Section View



Lookout Detail

ISS/REV:
AECOM FILE NAME: 60339707_Opt2_LA_ELEVATION.dwg Saved By: viberg PLOT: 15/06/04 11:40:54 AM B SIZE 11" x 17" (279.4mm x 431.8mm)

AECOM

LANDSCAPING
ELEVATIONS AND SECTION OF ALTERNATIVE 2
Figure 12

2.10.1 Active Transportation Path

On the preferred design the Active Transportation Pathway runs on the west side the roadway. The path would be 4.0 m wide asphalt surfaced with a base suitable for sustaining maintenance vehicle traffic.

The pathway generally follows the roadway with wide curves in areas where space allows. Pedestrian crossing points at roadway intersections have been located with pedestrian safety in mind. Excessive slopes have been avoided to facilitate Universal access in order to accommodate all users of all ages and abilities through the use of barrier free access, rest stops, and benches.

The pathway should be lit by pedestrian light standards for safety and security. The new pedestrian lights should be of the same style of lights and poles used along the existing multi-use path on Crescent Road, to unify the new with the old. The path could have a centre yellow stripe for safety reasons, separating traffic flows.

2.10.2 Trees, Shrubs and Groundcovers

Where possible, existing trees should be retained and protected during construction. This serves the dual purpose of providing some immediate vegetation and minimizing landscaping costs. Some minor pruning and removal of deadwood should be included in the construction contract.

Trees are used throughout to give a 'Park-like' setting to the causeway. The intent of the plantings is to soften the overall look and provide visual interest, as well as define the separation between the roadway and the Active Transportation Pathway.

A variety of species should be used and monocultures discouraged (a single species of tree). Use of some of the same species of trees and shrubs found on Island Park and along Crescent Road would help unify the new design with the old, such as Ulmus (Elm) and Fraxinus (Ash) varieties. Selection should be based on species hardy to Portage la Prairie (Zone 3a), height and spread, as well as seasonal interest. Shrubs could typically include a range of hardy species, especially salt-tolerant varieties, installed in mulched planting beds, with 300 mm depth of topsoil. Ground covers could range from sod near the intersections to salt-tolerant grasses along the roadway, and native grasses along the pathway and on the slopes.

Consideration should be given to the alignment for the Three Lane Causeway alternative to minimize effects of vehicular headlights on surrounding resident homes. Additional shrubs or plantings could be placed strategically to mitigate these types of effects.

2.10.3 Hard Landscaping / Site Amenities

A rest stop and single benches are located along the Active Transportation Pathway as well as a lookout, to take in the surrounding sights. The lookout is also intended to be used for the 'firework setup area'. For a cohesive design the use of the same hard surfacing material (colour and style) are to be used in all the hard surfacing locations.

Street lighting should be installed along the roadway for vehicles or cyclists using the road. Banner poles with electrical outlets should be placed opposite the street lights in order to enable the stringing up of holiday lights in the winter.

Additional lighting may be used beneath the bridge or culvert for small watercrafts in the summer and for snowmobilers, cross-country skiers, and skaters in the winter.

2.10.4 Bridge Aesthetics

The bridge aesthetics assumed for the project consist of either a concrete cast in place face or precast concrete panels. Whether it is a bridge structure or 'bridge-like' (such as an arch culvert), materials used can be made to look like a stone face through the use of texture and colour. The same method can also be incorporated into the lookout retaining wall feature, which will help tie design elements together.

2.11 Maintenance Requirements

The City of Portage la Prairie would prefer to have a low maintenance crossing for the Island Park Bridge Replacement. The current timber bridge needs frequent inspections and repairs. Ideally, the replacement option would be very low maintenance.

Alternative 1 would require the most maintenance of all the alternatives because a full length bridge entails more maintenance than a causeway. The bridge would need regular inspections, monitoring, deck testing and crack sealing in order to maintain its design lifespan.

Alternatives 2 and 3 require less maintenance than a full length bridge. The causeway portion of the crossing would require very minimal maintenance. The short span bridge/culvert would need to be inspected and maintained but since it is a much shorter length, there is less maintenance. A culvert option for the short span crossing would likely be less maintenance than a short span bridge. The Tupper alignment would require slightly more maintenance due to the fact that the causeway is longer and there would be the existing causeway for pedestrians as well as the vehicular causeway to maintain.

In all alternatives, the roadway, intersections and landscaping would require regular maintenance as with any infrastructure of this type.

2.12 Construction and Maintenance Costs

The costs associated with a project are generally very important in determining which alternative with which to proceed. Feedback from the Public Open House confirmed cost as one of the highest ranked evaluation criteria by the public. Class D cost estimates for the construction costs associated with each alternative are provided in Table 2-9 as part of the Evaluation Matrix.

2.13 Public Engagement Activities

Public engagement was a large component of the evaluation process and feedback was collected, analysed, and considered in the conceptual design phase of the Island Park Bridge replacement. The following summary provides an overview of the public engagement activities undertaken and the results obtained. Activities included: stakeholder meetings, a public open house and related email correspondence from the public and stakeholders. Activities commenced in February 2015 and are summarized until April 24, 2015.

2.13.1 Stakeholder Meetings

2.13.1.1 Stakeholder Identification

Stakeholders identified for the project included local community organizations and surrounding businesses. Stakeholders were provided with a copy of the questions in advance of the meetings and had an opportunity to review the Conceptual Design Alternatives during the meeting, along with images that could represent the potential structure.

Stakeholders that provided feedback for the project, through meetings or email correspondence, were from the following organizations:

- Heritage Committee.
- Active Transportation Committee.
- Portage la Prairie Community Revitalization Corporation.
- Portage la Prairie Chamber of Commerce.
- City of Portage la Prairie (Councillor).
- Portage Industrial Exhibition.
- Portage Golf Club.
- PCU Centre.
- Portage Regional Recreation Association.
- Mayfair Farms.

2.13.1.2 Stakeholder Meetings Summary

Stakeholder meetings were conducted for the project on February 19, 2015. Key stakeholders for the Project were identified by the City of Portage la Prairie. Invitations to the meetings were sent out by a City representative. The meetings were generally structured using the following questions as guidance for the discussions:

- Do you have any specific concerns with the existing bridge and causeway? How is your organization affected by these concerns?
- Are there any features of the existing bridge and causeway that you think should be incorporated into the conceptual design? Can you describe the features?
- When considering a new bridge or causeway design, are there any features that should be included in the design that would represent the local community interests?
- How could the City improve access for all modes of transportation accessing Island Park? (e.g. wider sidewalks, lighting, landscaping)
- What criteria should be included in the City's evaluation of the alternatives? (e.g. cost, construction timeline, design)

A total of 12 stakeholders participated in the meetings, representing 11 organizations. Mayfair Farms was unavailable to attend the meetings, but did submit their feedback to the City at a later time.

During discussions, the following comments were noted:

- Pedestrian safety should be of importance in any design alternative.
- Traffic flow was noted as a common concern for the existing bridge and improved traffic flow was considered an important factor for the new bridge design.

- The overall cost of the project was important to stakeholders, including low ongoing maintenance costs for the bridge.
- The design should be consistent with surrounding area and future development on the island (landscaping, paved paths, lighting, lookout points and an area for fireworks).
- Environmental concerns were noted related to riparian management, sources of fill and water flow/quality in the lake.
- Safe access under the bridge for users year-round (e.g. lighting, multiple areas with proper clearance).
- The design, including manoeuvering around roundabouts, should accommodate all types of vehicles including large trucks.

2.13.2 Public Open House

2.13.2.1 Summary of Open House

A Public Open House was hosted by the City of Portage la Prairie on April 9, 2015 at the PCU Centre. The Open House was attended by 191 people. The Open House was a drop-in format and was designed to provide the public with an opportunity to:

- Review the three conceptual design alternatives.
- Discuss the Project with the project team.
- Provide feedback on the alternatives, design options and landscaping concepts.

The open house included the following:

- 15 Story Boards highlighting key project information.
- A traffic analysis video modelled after four (4) different traffic options.
- A video of a 3-D Model based on Alternative 2 (causeway with three arch culverts).
- Feedback Forms for submission following review of the materials.

2.13.2.2 Analysis of Open House Feedback Forms

A total of 141 feedback forms and one (1) hand drawn figure of a preference was received at the Public Open House on April 9, 2015. As of April 17, 2015, four (4) additional forms were received by the City of Portage la Prairie and are included in the summary tables. The following subsections summarize responses to each of the Feedback form questions received.

2.13.2.3 How Respondents Were Informed of Events

Respondents, those who returned hard copy Feedback Forms, were asked how they heard about the project (by newspaper, Portage la Prairie Website, PortageOnline Website, word of mouth, radio, social media or other).

Table 2-5: Sources of Notification for Open House

Source	Total Responses
Portage la Prairie Website	23
Newspaper	43
PortageOnline Website	43
Word of Mouth	46
Radio	67
Social Media	18
Other	14

Respondents who indicated they heard about the project by "other" means included Council Communication, Chamber Meeting, Portage Online Facebook Page and City Hall.

Note: Individual respondents could give more than one answer. There were 254 responses from the 145 Feedback forms returned.

2.13.2.4 Comments on whether the Open House was Helpful

In all, 139 responses were received regarding whether the Open House was helpful to understand the objective and proposed alternative solutions for the project. A total of 134 people thought the Open House was helpful and five (5) people did not find the Open House helpful.

2.13.2.5 Criteria for Evaluating Alternatives

Respondents were asked to indicate the three (3) criteria they thought were most important for evaluating the bridge alternatives. A total of 437 responses were received from the 145 feedback forms and are summarized in the table below.

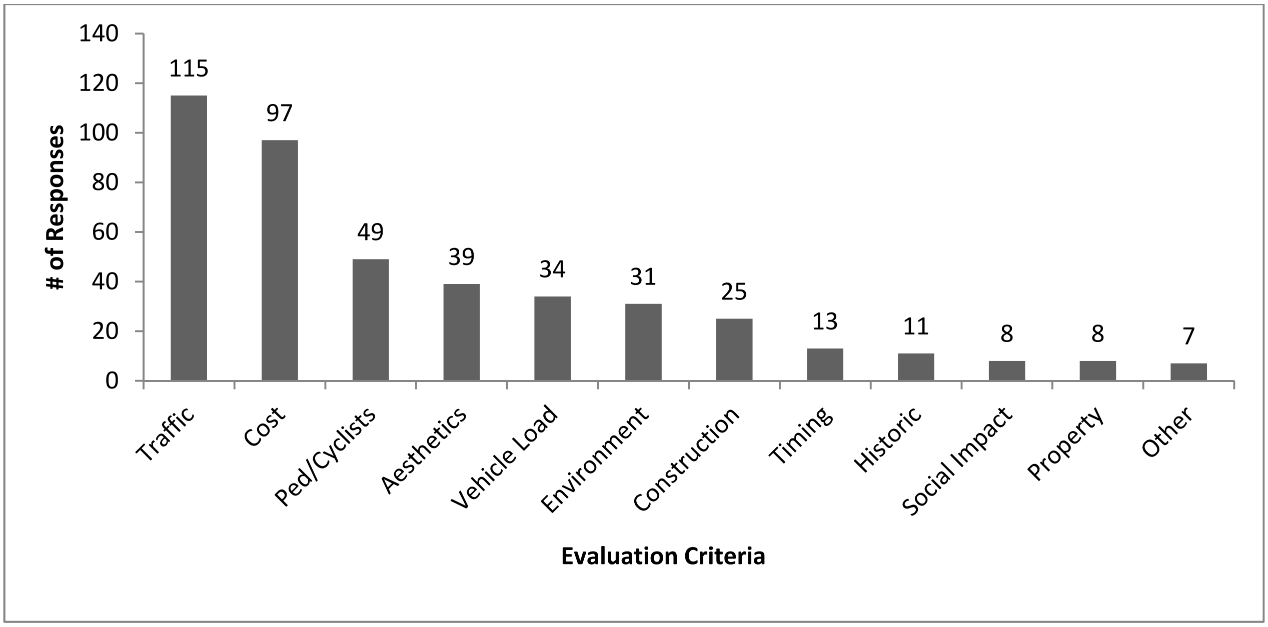


Figure 13: Level of Importance for Evaluation Criteria

Respondents who indicated "other" included:

- Snow and ice removal.
- Accessibility for large trucks and equipment which may be necessary for future shows or concerts.
- Maintenance.
- Concern regarding the impact a new bridge at Tupper Street would have on adjacent property values and aesthetic impacts.
- Maintain the access to both bodies of water on either side of the crossing for boats, snowmobiles, etc.
- Not a fan of roundabouts as even the existing Winnipeg ones get used wrong.

2.13.2.6 Preference of Alternatives

Outlined on the Feedback forms was a summary of the three bridge alternatives as shown below:

Table 2-6: Sample Table from Feedback Form

Summary of Three Alternatives		
Alternative 1 New Bridge	**Alternative 2 New 3 Lane Causeway**	**Alternative 3 Tupper Alignment**
• **Full length 2-lane bridge.** • **Highway traffic loading.** • **Short span steel pedestrian bridge on existing causeway.** • **May include roundabouts.**	• 3-lane causeway with short span bridge or culverts in centre. • Active Transportation Path for pedestrians would either cross along bridge or have a separate pedestrian bridge. • May include roundabouts.	• New three lane causeway similar to Alternative 2, but aligned with Tupper Street. • Existing causeway used for active transportation path with separate pedestrian bridge. • May include roundabouts.

Participants were asked to rank the three alternatives based on their preference; **Most Preferred**, **Preferred** and **Least Preferred** and responses are summarized as follows:

Note: Several respondents selected more than one alternative as a preference.

The summary of alternative preferences is as follows:

- The most preferred option was Alternative 2 – the New 3-Lane Causeway
- The next most preferred option was Alternative 3 – Tupper Alignment.
- The least preferred was Alternative 1 – the New Bridge, as illustrated in the following figures.

2.13.2.7 Reasoning for Alternative Preference

Respondents were asked to explain reasons for their Alternative preference by selecting yes or no from a series of statements.

Table 2-7: Reasoning Statement Responses

Reasoning Statement	Yes	No
Historically it is important to have a long bridge.	13	91
A landscaped causeway will look better than a bridge.	88	17
I support roundabouts if they improve traffic.	79	39
Traffic flow is a problem after large events.	94	18
Impact on residents/properties is a significant issue.	65	28
Cost is the most important factor.	61	43

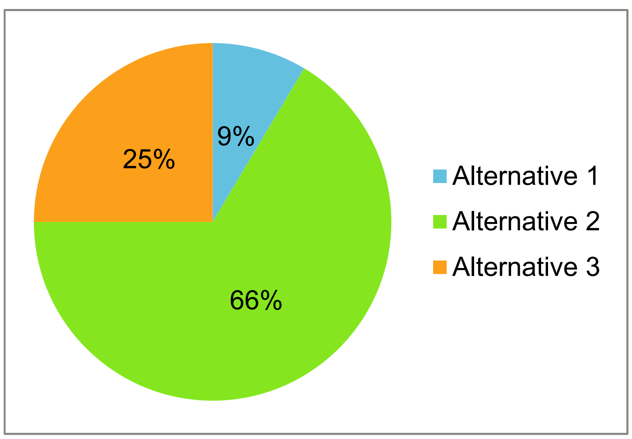


Figure 14: Most Preferred Alternative (% of Responses)

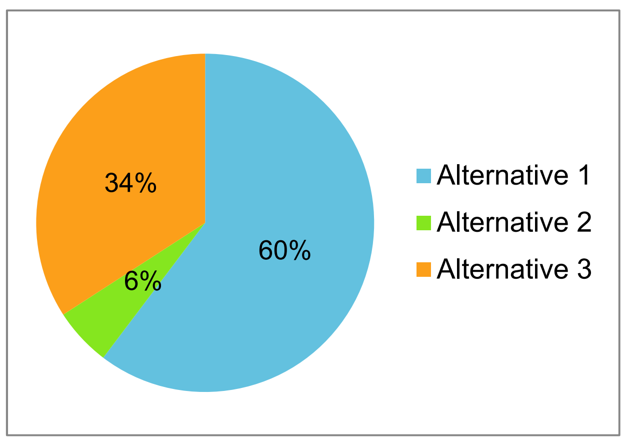


Figure 15: Least Preferred Alternative (% of Responses)

Other reasons for respondent's preferences included:

- I'd like to see existing bridge re-purposed as a pedestrian link.
- Lowest cost to build and maintain. Our infrastructure is old and we need to keep funds that are affordable.
- A proper bridge maintains the image of a "true" lake. The "landscaped" causeway is going to impede lake views.
- Safety in case of emergencies if there is no traffic flow off of the island.
- Oversized traffic could have issues with roundabouts.
- Cost is important and funds should be spent wisely for a community our size.
- Roundabouts are confusing.
- Not sure why roundabouts are needed.

2.13.2.8 Preference Statement Options

Respondents were asked their preference between three (3) pairs of statements and 335 responses were received.

Table 2-8: Preference Statement Responses

Statements	Number of Responses	Preference
4- Way Intersection or Roundabouts	41 - intersection **73** - roundabout	**Roundabout**
A Short Bridge or Multiple Culverts	60 - Short Bridge **62** – Multiple Culvert	**Almost Equal**
Separate Pedestrian Bridge or Pathway on Bridge/Culvert	41 – Separate Pedestrian Bridge **69** – Pathway on Bridge/Culvert	**Pathway on Bridge/Culvert**

2.13.2.9 Additional Comments

Respondents were asked for any additional comments they may have regarding the project and included:

- Get this right; only one chance in a lifetime. Important to preserve character of waterway.
- I am a fan of a causeway with culverts alternative and I think it will be an excellent improvement to our bridge and city. As a Millennial in Portage I am very excited about the changes and steps our city is taking aesthetically and functionally.
- Royal Road is only option, not Tupper. South Tupper is not and was not built for trucks. Tupper North was. Royal Road was built for truck traffic stop signs only no turnabouts.
-
- I am totally in favour of roundabouts for traffic flow. We did spend $43 million on PCU Centre. This could be at least as important into the future. If Alternative #1 is out of the question, then I would rate Alternative #2 as second.
- I love option #2; very classy! It is time Portage moved into a new era. Turnarounds in Europe have proven more efficient for traffic flow, safer and Option #2 also becomes an interesting tourist attraction. It's time to plan for a future generation folks and well done!
- Councillor Draycoft was very helpful in explaining roundabouts. I was scared of them (like most people)! I appreciate the info night. Thank-you for helping inform the community and keeping us included in these decisions. I'm very excited – it was a fiasco trying to leave the PCU Centre on Remembrance Day!

- Culverts – regardless of diameter and height may increase snowmobile accidents due to misjudgement and speeds that the machines can go. Oversized traffic regularly uses the bridge and could have issues even with semi-sized roundabouts.
- We are building this for future generations.
- Make sure lines are painted on causeway at all times.
- Along Crescent Road there is no place to stop if you want to view the lake or answer your phone. Why not have an area to pull over especially in the west end where there is a lot of grass before the lake.
- Alternative #3 will have the least impact on use/access during construction and is therefore my preference. Landscaping shown in mock-ups is quite beautiful and quite completed, hope that’s in the budget also.
- Curious about Christmas lights! They are one of my favourite things about our community. I would appreciate if the current bridge could be retained for the use of active transportation. Hope to see active transportation receive acknowledgment of its importance in our community.
- People have enough trouble with 4-way stops, roundabouts would be a disaster.
- I look forward to the much needed improvement on the bridge.
- Roundabouts will cause confusion among seniors in Portage.
- Please continue to engage the public as we are the people that pay taxes.
- Proper access under bridge, culverts are important for leisure activities. It will also maintain “island” theme.
- Can we get the semi-trucks and large equipment through the roundabouts?
- I like the opportunity to propel Portage la Prairie forward.
- We have a lot of debt due to PCU, so we should avoid huge costs on this project.
- The reason for Tupper Street vs. Royal Road is it is a wider road and with two funeral homes on Royal Road at times can be a huge safety factor with congestion. The Tupper Street is direct North to the 240. Most semi drivers prefer Tupper over Royal until they have to turn the temporary causeway.
- As you can see, my wife and I are for this project but we are also for waiting until the time is right IF this project means raising money for it by raising the taxes again. Especially is this true for people like us who are living on very fixed and limited incomes that don't go up very often. I think this is very true for some of our seniors and for some young couples just beginning in life. So cost is what is of most concern. We did receive a very nice email from Mr. Kelly Braden in this regard that most of the funding would come from sources other than tax levies? But we find that very hard to accept, although we hope it’s true. The project does need to be done at some point that is true, but street repairs and other infrastructure will also need very much attention...just take a drive around our city and that will become quickly evident. Look at that 9th St SE for example going past our new Portage Clinic. That is awful! So we are just concerned about the timing and cost of this project. Whenever we have to do something we have to save for it...because we don't have the option of spending OTHER PEOPLES money...and it is becoming obvious to us that is what may be done here yet again. Just our opinion and we know that this will go ahead anyway no matter what we say, but it’s important for us to have our say. Thank you.
- How would the roundabouts work in the winter with the snow loads we get?
- Roundabouts will confuse a lot of people and lose the beautiful long curving drive along the crescent. Why not traffic lights at both ends, i.e. Royal and PCU corners intersections.
- Roundabouts would make it difficult for pedestrians and cyclists to cross the roadway.
- Proper landscaping will make this look very professional. Keep up the good work.
- Option 2 – 3 lane causeway with arched culverts – least amount of maintenance in future. It is also aesthetically pleasing which is important as Island Park is a gem to the City.
- I think the causeway can be built to be attractive and useful.
- If Alternative 3 is used, the old causeway should be removed and place the walking path beside the road. The stop sign at Tupper and Dufferin would have to be reversed. You have a beautiful area – do it right.
- Tupper Street is narrow at the south end. Obviously designers didn’t come to look at the real site. Roundabouts are scary as lots of seniors who have issues driving would attempt to use them. Pedestrians really not considered in plans - especially children who would need to be well educated so as not to be

injured. Editor's Note: Tupper St. has the same right-of-way width along its entire length, and it has the same width as Royal Road. The paved surface, however, is narrower.

- I know that roundabouts are efficient, but I am sceptical that Portage residents will adapt to them (Will some try to back up as they now do when they miss a turn). 4-way stops and pedestrians equal chaos. What about traffic controlled lights?
- A three arch culvert faced with stone in the centre of a 3 lane causeway would be very attractive. The causeway would be landscaped improving the look. The fireworks could still be launched from the causeway. The bridge is more important than the Sask. Ave proposals.
- Use existing bridge for walk-way with seating so people can enjoy the scenery, plus our new constructed causeway.
- I like the idea of connecting Tupper.
- Leave old bridge to be used as a pedestrian walk way and bike path.
- Traffic lights at north end of bridge and roundabout at south end.
- No need to build a walkway, the wooden bridge is sufficient. No culverts whatsoever. 4-way intersection on both sides with lights on Royal Road. Coming onto the island a turning lane is in place to golf course.
- Thank you for the wonderful designs. As a millennial, I'm excited to see Portage moving forward to grown and maintain our wonderful city. Looking forward to the changes regardless of the final decision.
- As a worker of the PCU Centre since opening, I think three lanes on the bridge would benefit many things; emergencies, heavy traffic after major events (hockey, wedding, funeral, graduation…)

2.13.3 Email Feedback

The City has received feedback related to the Project through email correspondence, including the following:

- A separate submission was received from a Portage la Prairie resident. The email included a copy of a letter and article from *The Portage Daily Graphic*, which highlights the potential for developing the existing bridge as a tourist attraction. The article includes a sketch of the potential structure, which would be a covered timber bridge.
- Following the Open House, the City also received the following comment by email: "I would strongly request city council to reconsider island access as a whole, incorporating a second access location, thereby providing for future island development as well as current needs…My suggestions regarding the current Island access is to refurbish the existing bridge including pedestrian walkways on both sides of the bridge, similar to the partial one on the west side now, for the full length of the bridge. Improved entrance and exit lanes could be developed, without incorporating round-a-bouts, using the familiar 4 way stop regime. Remove the current causeway completely, heavy Mayfair Farms loads need not be a consideration, service trucks are generally lightly loaded and the current bridge has the capability until the new bridge/causeway access is constructed on the east side of the island." *Editor's Note: The current bridge does not have the capacity for heavy trucks and the City does not currently have plans for a second access to the island. The sidewalk is also no longer on the bridge and has been moved to the temporary causeway.*

2.14 Evaluation Matrix

The evaluation matrix can be found below in Table 2-9. Each performance evaluation criteria was assigned an importance factor between 5 and 25 as agreed upon between AECOM and the City. The selected weighting also generally reflected the public feedback. The higher the importance factor, the more important the criteria, and the more weighted its rating will be in the evaluation. The total sum of all importance factors was set to 100 in order to easily compare the results in percentages.

The weighted performance criterion gives each alternative a total amount of points out of 100. The performance comparison ranks the best alternative at 100% and then ranks each of the other alternatives lower with respect to the best ranked alternative.

The cost valuation of each alternative gives a snapshot of the value of each alternative. The cost valuation is calculated by dividing the total construction cost by the total weighted points received from the performance evaluation. This metric indicates which alternative offers the best value for the cost.

Table 2-9: Evaluation Matrix

Island Park Bridge Replacement		**New Bridge**		**3 Lane Causeway**		**Tupper Alignment**	
Performance Evaluation Criteria	**Importance Factor**	**Rating (out of 5)**	**Weighted Rating**	**Rating (out of 5)**	**Weighted Rating**	**Rating (out of 5)**	**Weighted Rating**
Right-of-Way & Property	5	**4**	4	**4**	4	2	2
Utilities	5	**4**	4	**4**	4	2	2
Environmental	10	**4**	8	3	6	3	6
Historic & Archaeological	5	**5**	5	3	3	2	2
Level of Service / Traffic Flow / Pedestrians and Cyclists	25	2	10	4	20	**5**	25
Construction Staging / Constructability / Schedule	15	**4**	12	3	9	**4**	12
Public Perception / Aesthetics	25	2	10	**5**	25	4	20
Maintenance	10	3	6	**5**	10	**5**	10
Total	100		59		81		79
Performance Comparison		**73%**		**100%**		**98%**	

Cost Evaluation	**$**	**$**	**$**
Construction Costs	$15,000,000	**$6,500,000**	$7,500,000
Maintenance Costs	Highest	**Lowest**	Medium
Cost Valuation (Cost per Point)	$254,237	**$80,247**	$94,937

Assumptions for the cost estimates:

- Based on Class D conceptual level engineering
- Do not include compensation for destruction of fish habitat
- Do not include engineering fees

3. Conclusions and Recommendations

3.1 Conclusions

Alternative 2 received the highest total points in the performance evaluation, and it was estimated to be the lowest cost option. Its cost valuation was calculated by dividing the construction costs by the total weighted points received, and Alternative 2 received the best cost valuation as compared to the other two alternatives.

Alternative 3 received a very similar score to Alternative 2 in the performance evaluation criteria. However, due to its higher construction costs, Alternative 3 still ranks lower than Alternative 2 in the cost valuation.
Alternative 1 received the lowest total points in the performance evaluation, and it was estimated to be the highest cost option. Alternative 1 received the poorest cost valuation of all alternatives and will not be recommended.

It was also concluded that the third lane of the Island Park Bridge would have a very significant impact on the traffic flow leaving the island. The north intersection at Crescent Road would improve from a Level of Service (LOS) of F to a LOS of D with the addition of the third lane. The same intersection would improve to a LOS of A with the use of roundabouts and the 3 lanes of traffic. (Note that the addition of roundabouts with only 2 lanes of traffic is of no benefit.)

The south intersection at George Hill Drive would remain at a LOS of D with the addition of a third lane. However, the use of roundabouts and the 3 lanes of traffic would yield a LOS of C for the southern intersection. Both 4-way intersections and roundabouts are feasible options for the proposed project. Roundabouts can also be designed to accommodate the longer truck traffic.

3.2 Recommendations

AECOM recommends that the City of Portage la Prairie proceed with the preliminary and/or detailed design of Alternative 2, a new 3 lane causeway with a short-span bridge or culvert to provide clearance for recreational users of Crescent Lake. This alternative includes:

- One southbound lane and two northbound lanes. The right northbound lane would be right-turn-only at Crescent Road. The second northbound lane provides a significant improvement to traffic flow after major events on the island.
- Either 4-way stops or roundabouts at the intersections north and south of the causeway. The roundabouts provide a further improvement to the traffic flow, with only an incremental cost increase to the entire project. For Alternative 2, it is estimated that the cost increase from 4-way stop to roundabouts would be approximately $350,000. From those attending the Open House, 64% of the public is in favour of roundabouts if they improve traffic flow, which they do. However there is also a segment of the respondents that are strongly opposed to roundabouts. Once residents become accustomed to using roundabouts approval is likely to increase further. If the overall cost is determined to be the most important factor or if sufficient funds are not available, roundabouts could be added at a later date.
- A short three or four span bridge, or a three arch culvert option. A cast-in-place box culvert has benefits for design, construction and long-term maintenance, however the public strongly supported improved aesthetics, and box culverts may be less visually appealing than other alternatives. Several bridge and arch culvert options exist and require further analysis in the preliminary design.
- An Active Transportation Pathway traveling over the bridge/culvert as opposed to a separate active transportation bridge.

- Construction will likely require staging to mitigate issues with settlement and consolidation, including differential settlement between structures and the causeway. It is anticipated that construction will extend over two winter seasons to allow for this, and to ensure continuous access to the island.

The preliminary design should include the following:

- Site survey to confirm existing and proposed roadway, structure and causeway geometry.
- Additional geotechnical investigation and detailed design will be required to determine foundation alternatives, causeway/embankment slopes, slope stability analysis, settlement, and consolidation criteria. The unfavourable underlying soil conditions will have an impact on the type of short-span bridge or culvert option chosen. Deep pile foundations are preferred to support the proposed bridge on poor soils; however, the culvert options may also require deep foundations. High construction cost is expected for bridge and culvert options and concerns regarding long-term performance would need to be addressed.
- A review of potential impact of the widened causeway on the existing watermain (this is anticipated to be minimal with Alternative 2, however side slopes are subject to change with the geotechnical design).
- An expanded traffic study to include pedestrian traffic counts during major summer events to determine effects on the conceptual design alternatives. The design would include optimization and further recommendations for pedestrian crossings. It is not recommended that a sidewalk be added to the east side of the bridge or causeway, as this will have negative impacts on the traffic at Royal Road and George Hill Drive due to pedestrians crossing at the northbound entrance to the causeway.
- Environmental review and applications, including determination of fish habitat in Crescent Lake.
- Review of Crescent Lake summer and winter water levels including drainage into and out of the lake, and hydraulics of the intake and outlet. This will ensure an adequate clearance envelope is provided for summer and winter recreational use.
- Preliminary structural design of culvert and bridge options in accordance with geotechnical recommendations in order to determine the optimum structure. The bridge option would likely include precast concrete girders with steel pile foundations. The culvert options would include triple steel or concrete open bottom arches on deep foundations, or triple steel pipe arches. The culvert options would likely include Mechanically Stabilized Earth (MSE) retaining walls. Differential settlement between the MSE walls and culverts will need to be addressed in the design.

Appendix A

Trafficware Synchro Detailed Results

Intersection	
Intersection Delay, s/veh	82.4
Intersection LOS	F

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	4	44	4	0	4	44	16	0	262	381	385
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Mvmt Flow	0	4	44	4	0	4	44	16	0	262	381	385
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	9.5	9.5	93.5
HCM LOS	A	A	F

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	25%	8%	6%	40%
Vol Thru, %	37%	85%	69%	30%
Vol Right, %	37%	8%	25%	30%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	1028	52	64	40
LT Vol	262	4	4	16
Through Vol	381	44	44	12
RT Vol	385	4	16	12
Lane Flow Rate	1028	52	64	40
Geometry Grp	1	1	1	1
Degree of Util (X)	1	0.086	0.104	0.056
Departure Headway (Hd)	4.131	5.951	5.822	5.024
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	884	605	619	716
Service Time	2.144	3.959	3.829	3.036
HCM Lane V/C Ratio	1.163	0.086	0.103	0.056
HCM Control Delay	93.5	9.5	9.5	8.3
HCM Lane LOS	F	A	A	A
HCM 95th-tile Q	36.1	0.3	0.3	0.2

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	16	12	12
Peak Hour Factor	100	100	100	100
Heavy Vehicles, %	0	0	0	0
Mvmt Flow	0	16	12	12
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	8.3
HCM LOS	A

Lane

Intersection	
Intersection Delay, s/veh	32.7
Intersection LOS	D

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	560	0	0	0	0	4	8	0	12	460	0
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Mvmt Flow	0	560	0	0	0	0	4	8	0	12	460	0
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	41.2	9.1	24.2
HCM LOS	E	A	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	3%	100%	0%	0%
Vol Thru, %	97%	0%	33%	80%
Vol Right, %	0%	0%	67%	20%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	472	560	12	20
LT Vol	12	560	0	0
Through Vol	460	0	4	16
RT Vol	0	0	8	4
Lane Flow Rate	472	560	12	20
Geometry Grp	1	1	1	1
Degree of Util (X)	0.738	0.868	0.02	0.035
Departure Headway (Hd)	5.629	5.582	5.948	6.339
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	642	650	598	561
Service Time	3.677	3.624	4.025	4.419
HCM Lane V/C Ratio	0.735	0.862	0.02	0.036
HCM Control Delay	24.2	41.2	9.1	9.7
HCM Lane LOS	C	E	A	A
HCM 95th-tile Q	7.7	14.6	0.1	0.1

Intersection	
Intersection Delay, s/veh	9.3
Intersection LOS	A

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	52	64	1028	40
Demand Flow Rate, veh/h	52	64	1028	40
Vehicles Circulating, veh/h	32	647	64	310
Vehicles Exiting, veh/h	318	60	20	401
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	15	15	15	15
Ped Cap Adj	0.998	0.998	0.998	0.998
Approach Delay, s/veh	3.7	7.4	9.9	4.8
Approach LOS	A	A	A	A

Lane	Left	Left	Left	Bypass	Left
Designated Moves	LTR	LTR	LT	R	LTR
Assumed Moves	LTR	LTR	LT	R	LTR
RT Channelized				Yield	
Lane Util	1.000	1.000	1.000		1.000
Critical Headway, s	5.193	5.193	5.193		5.193
Entry Flow, veh/h	52	64	643	385	40
Cap Entry Lane, veh/h	1094	592	1060	1064	829
Entry HV Adj Factor	1.000	1.000	1.000	1.000	1.000
Flow Entry, veh/h	52	64	643	385	40
Cap Entry, veh/h	1092	590	1058	1062	827
V/C Ratio	0.048	0.108	0.608	0.363	0.048
Control Delay, s/veh	3.7	7.4	11.6	7.1	4.8
LOS	A	A	B	A	A
95th %tile Queue, veh	0	0	4	2	0

Intersection	
Intersection Delay, s/veh	15.1
Intersection LOS	C

Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	560	12	472	20
Demand Flow Rate, veh/h	560	12	472	20
Vehicles Circulating, veh/h	16	1032	560	16
Vehicles Exiting, veh/h	16	0	16	1028
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	15	15	15	15
Ped Cap Adj	0.998	1.000	0.998	0.998
Approach Delay, s/veh	9.0	9.4	23.0	3.3
Approach LOS	A	A	C	A

Lane	Left	Left	Left	Left	Bypass
Designated Moves	LTR	LTR	LTR	LT	R
Assumed Moves	LTR	LTR	LTR	LT	R
RT Channelized					Yield
Lane Util	1.000	1.000	1.000	1.000	
Critical Headway, s	5.193	5.193	5.193	5.193	
Entry Flow, veh/h	560	12	472	16	4
Cap Entry Lane, veh/h	1112	403	645	1112	1112
Entry HV Adj Factor	1.000	1.000	1.000	1.000	1.000
Flow Entry, veh/h	560	12	472	16	4
Cap Entry, veh/h	1110	403	644	1110	1110
V/C Ratio	0.505	0.030	0.733	0.014	0.004
Control Delay, s/veh	9.0	9.4	23.0	3.4	3.3
LOS	A	A	C	A	A
95th %tile Queue, veh	3	0	6	0	0

Intersection	
Intersection Delay, s/veh	30.4
Intersection LOS	D

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	4	44	4	0	4	44	16	0	262	381	385
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Mvmt Flow	0	4	44	4	0	4	44	16	0	262	381	385
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	1

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	2	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	2	1	1
HCM Control Delay	9.5	9.4	33.6
HCM LOS	A	A	D

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	41%	0%	8%	6%	40%
Vol Thru, %	59%	0%	85%	69%	30%
Vol Right, %	0%	100%	8%	25%	30%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	643	385	52	64	40
LT Vol	262	0	4	4	16
Through Vol	381	0	44	44	12
RT Vol	0	385	4	16	12
Lane Flow Rate	643	385	52	64	40
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.906	0.445	0.085	0.102	0.056
Departure Headway (Hd)	5.072	4.165	5.866	5.738	5.074
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	714	862	609	623	703
Service Time	2.805	1.898	3.914	3.783	3.127
HCM Lane V/C Ratio	0.901	0.447	0.085	0.103	0.057
HCM Control Delay	47.6	10.3	9.5	9.4	8.4
HCM Lane LOS	E	B	A	A	A
HCM 95th-tile Q	18.5	2.4	0.3	0.3	0.2

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	16	12	12
Peak Hour Factor	100	100	100	100
Heavy Vehicles, %	0	0	0	0
Mvmt Flow	0	16	12	12
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	2
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	8.4
HCM LOS	A

Lane

Intersection	
Intersection Delay, s/veh	32.7
Intersection LOS	D

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	560	0	0	0	0	4	8	0	12	460	0
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Mvmt Flow	0	560	0	0	0	0	4	8	0	12	460	0
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	41.2	9.1	24.2
HCM LOS	E	A	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	3%	100%	0%	0%
Vol Thru, %	97%	0%	33%	80%
Vol Right, %	0%	0%	67%	20%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	472	560	12	20
LT Vol	12	560	0	0
Through Vol	460	0	4	16
RT Vol	0	0	8	4
Lane Flow Rate	472	560	12	20
Geometry Grp	1	1	1	1
Degree of Util (X)	0.738	0.868	0.02	0.035
Departure Headway (Hd)	5.629	5.582	5.948	6.339
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	642	650	598	561
Service Time	3.677	3.624	4.025	4.419
HCM Lane V/C Ratio	0.735	0.862	0.02	0.036
HCM Control Delay	24.2	41.2	9.1	9.7
HCM Lane LOS	C	E	A	A
HCM 95th-tile Q	7.7	14.6	0.1	0.1

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	0	16	4
Peak Hour Factor	100	100	100	100
Heavy Vehicles, %	0	0	0	0
Mvmt Flow	0	0	16	4
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	9.7
HCM LOS	A

Lane

Intersection: 3: Royal Road & Crescent Road East

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	16.7	16.2	255.9	10.8
Average Queue (m)	7.1	9.0	251.0	6.5
95th Queue (m)	13.8	14.4	255.0	12.5
Link Distance (m)	74.1	206.0	253.5	118.2
Upstream Blk Time (%)			3	
Queuing Penalty (veh)			35	
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 5: Golf Course Road/George Hill Drive & Royal Road

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	73.4	7.5	56.2	10.8
Average Queue (m)	72.2	1.3	54.5	4.6
95th Queue (m)	73.3	5.2	65.6	11.7
Link Distance (m)	69.0	130.9	51.6	253.5
Upstream Blk Time (%)	51		84	
Queuing Penalty (veh)	286		0	
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: Royal Road & Crescent Road East

Movement	EB	WB	NB	NB	SB
Directions Served	LTR	LTR	LT	R	LTR
Maximum Queue (m)	13.4	13.5	71.9	35.5	14.2
Average Queue (m)	6.8	5.9	32.2	18.5	6.5
95th Queue (m)	12.3	10.8	55.4	28.4	13.0
Link Distance (m)	74.1	202.0	253.2	253.2	118.2
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (m)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 5: Golf Course Road/George Hill Drive & Royal Road

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (m)	66.4	9.2	56.2	9.3
Average Queue (m)	30.9	2.0	32.4	3.9
95th Queue (m)	57.0	7.9	56.7	10.6
Link Distance (m)	69.0	131.2	51.6	253.2
Upstream Blk Time (%)	1		4	
Queuing Penalty (veh)	4		0	
Storage Bay Dist (m)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Appendix B

Roadway Profile and Section Views

B SIZE 11" x 17" (279.4mm x 431.8mm)

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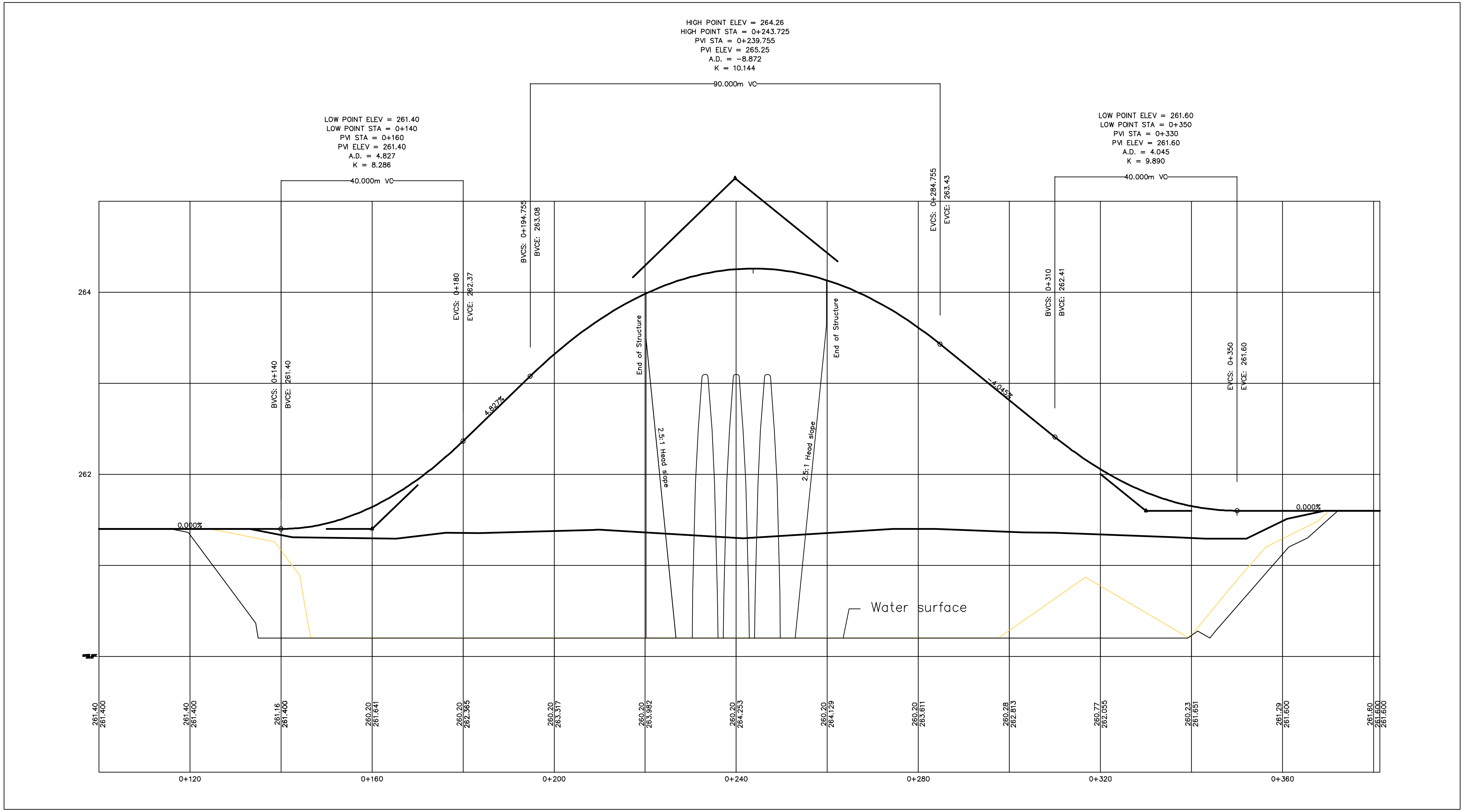
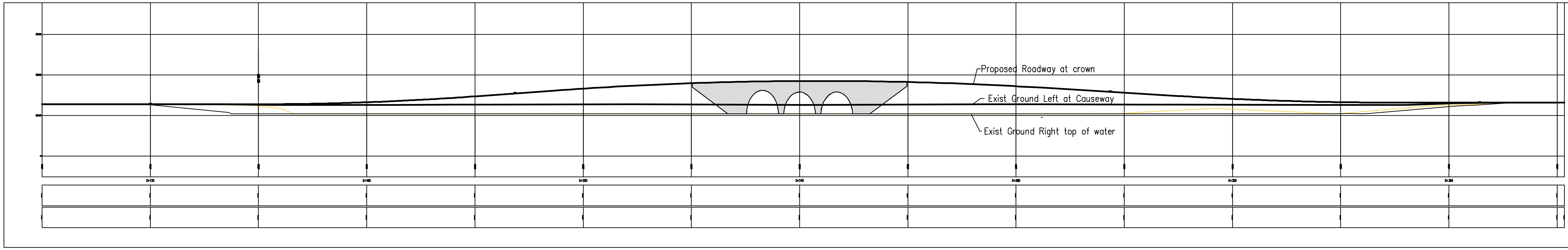
AECOM FILE NAME: AECOMv1-ANSI-FIG-BHL-M.dwt

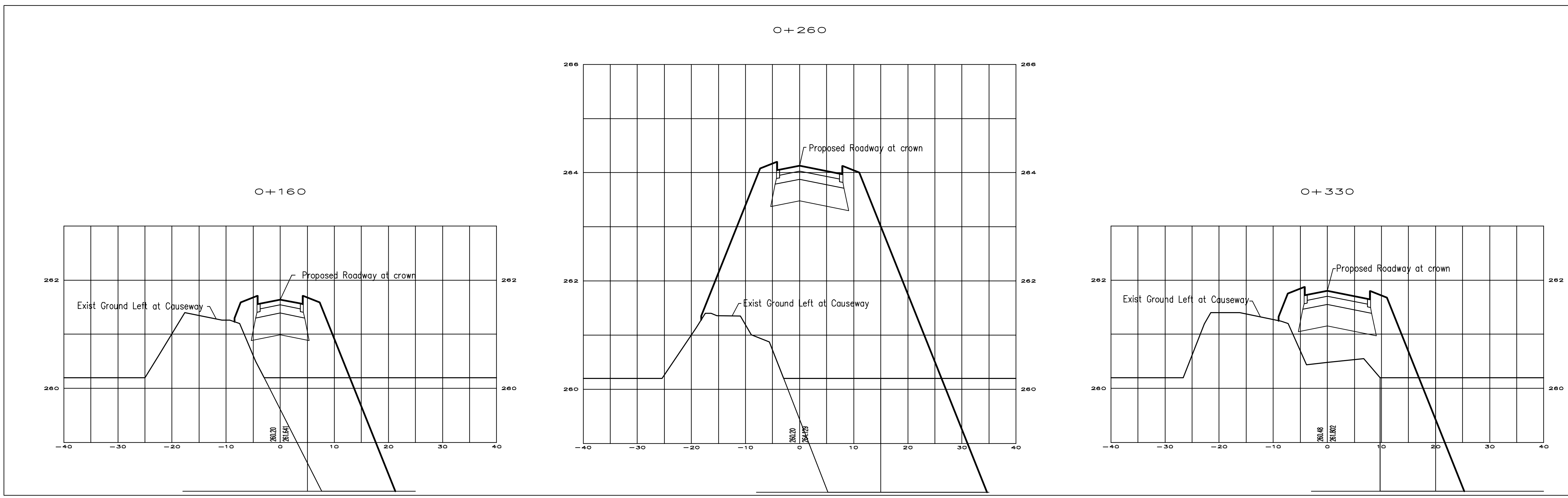
ISS/REV:



AECOM

ALTERNATIVE 2 - PROFILE VIEW
LOOKING EAST
SK-1





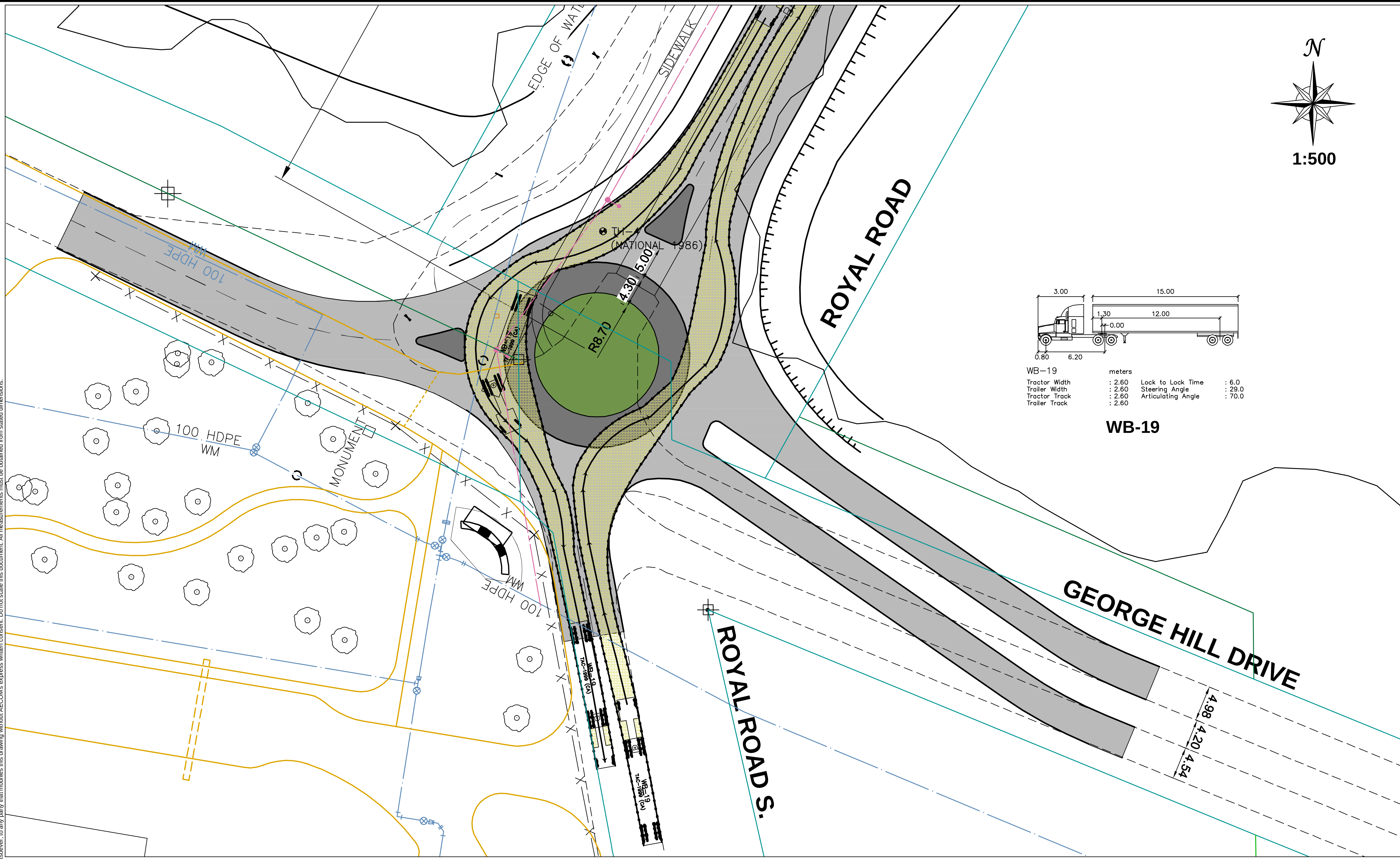
AECOM

ALTERNATIVE 2 - ELEVATION AND SECTIONS

SK-2

Appendix C

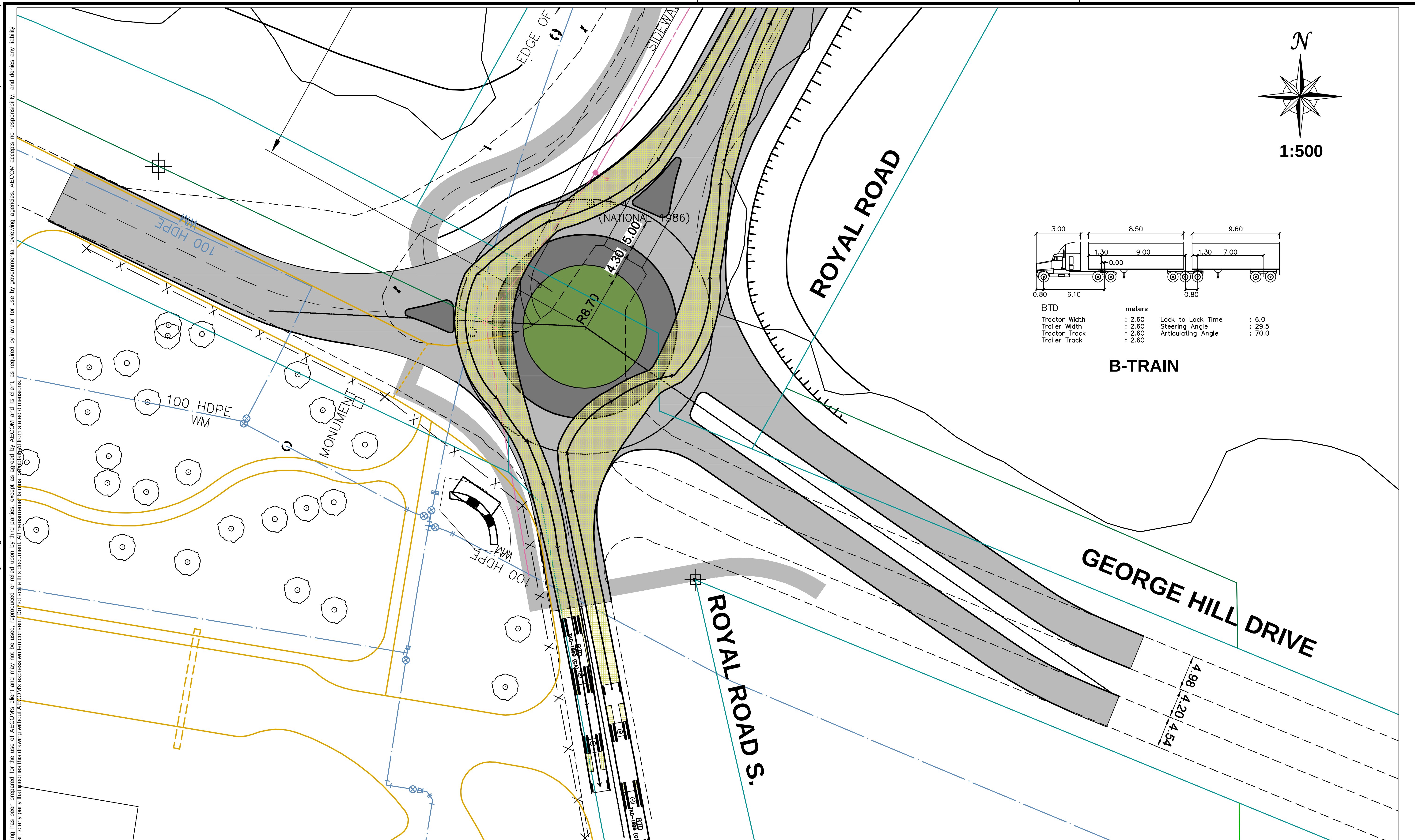
Truck Turning Movements



ISS/REV:
AECOM FILE NAME: AECOMv1-ANSI-FIG-BHL-M.dwt Saved By: viergutzd PLOT: 6/4/2015 9:42:22 AM B SIZE 11" x 17" (279.4mm x 431.8mm)

AECOM

TRUCK TURNING MOVEMENTS
FIGURE 1



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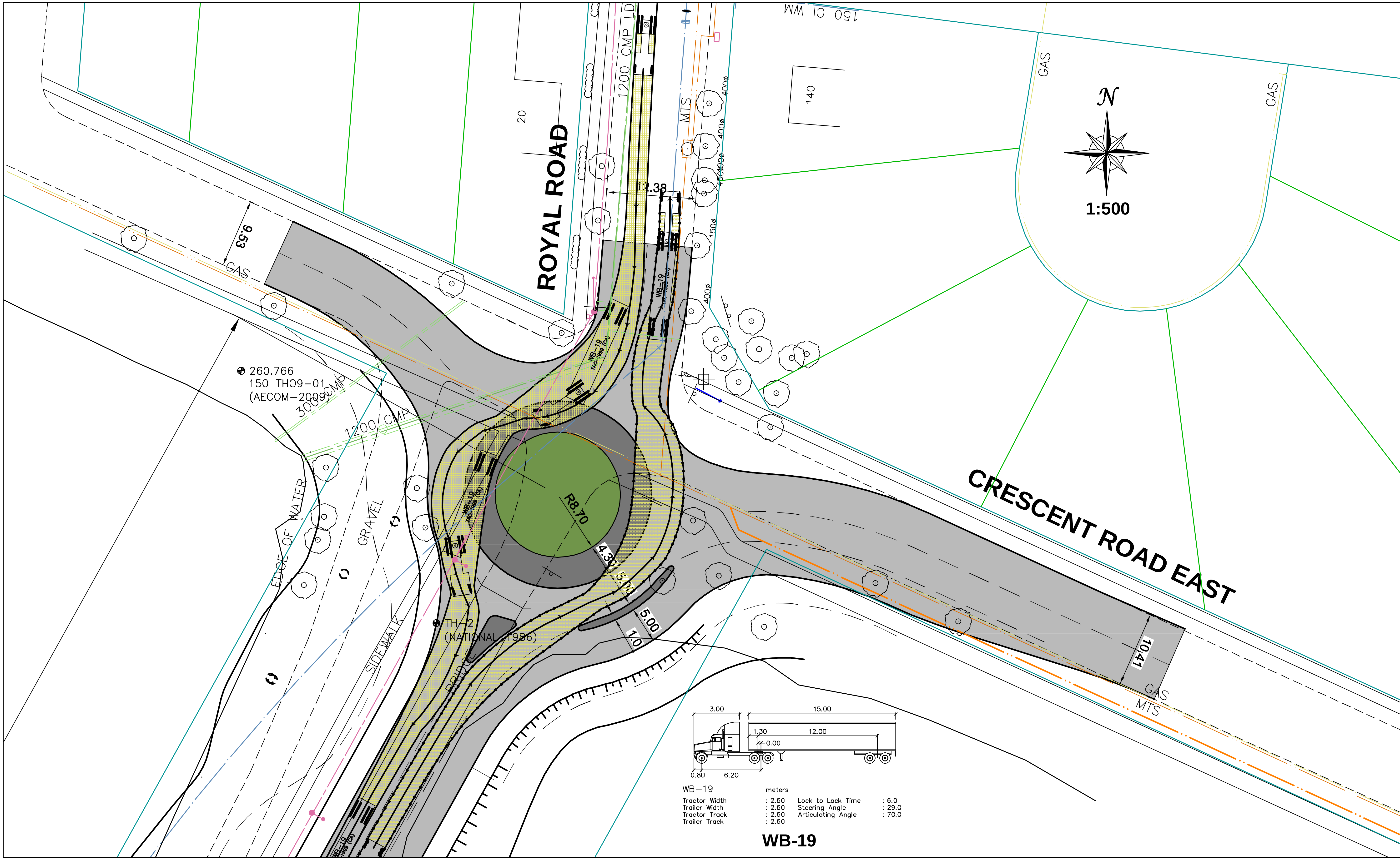
AECOM

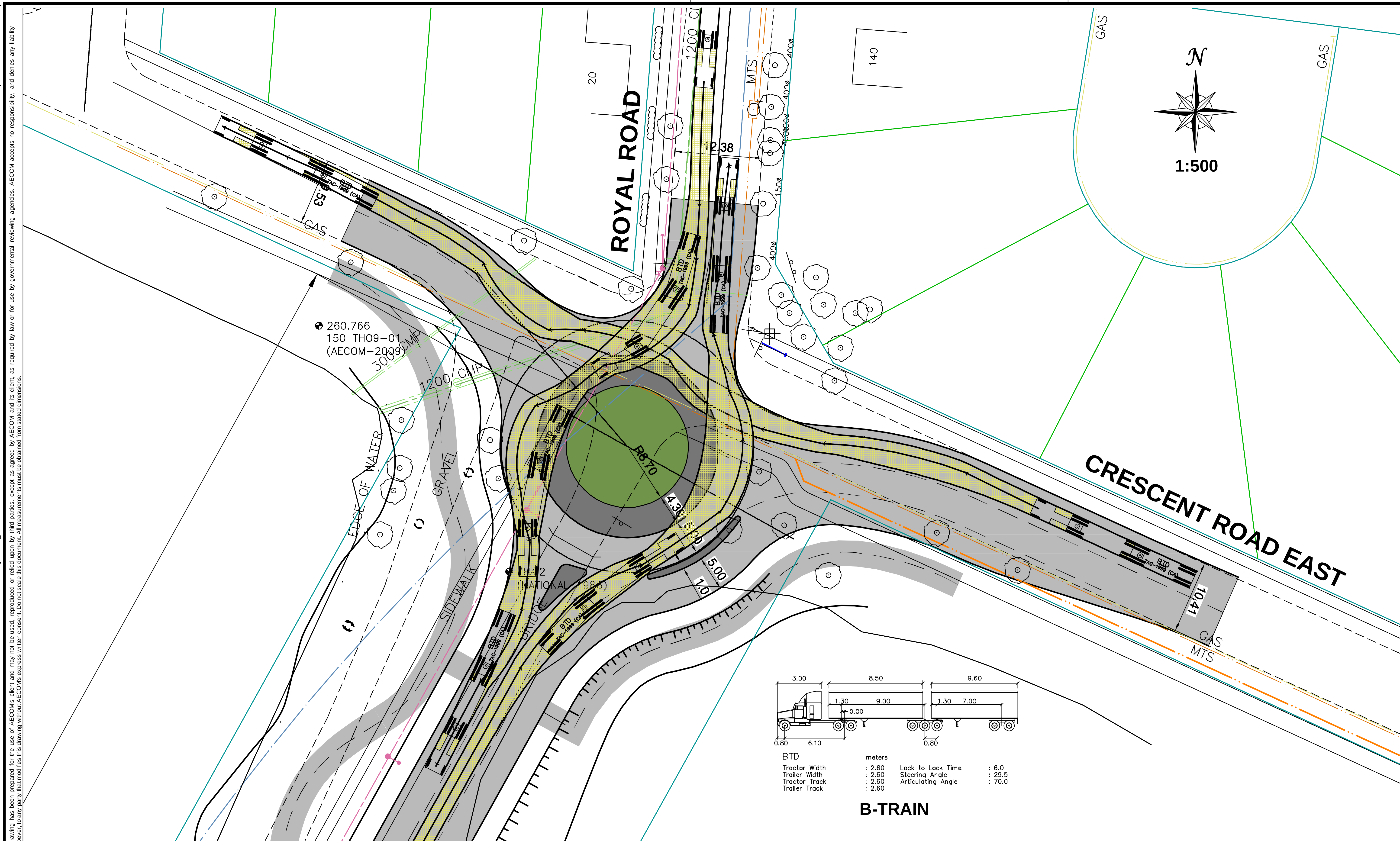
TRUCK TURNING MOVEMENTS

FIGURE 2



TRUCK TURNING MOVEMENTS

FIGURE 3



TRUCK TURNING MOVEMENTS
FIGURE 4

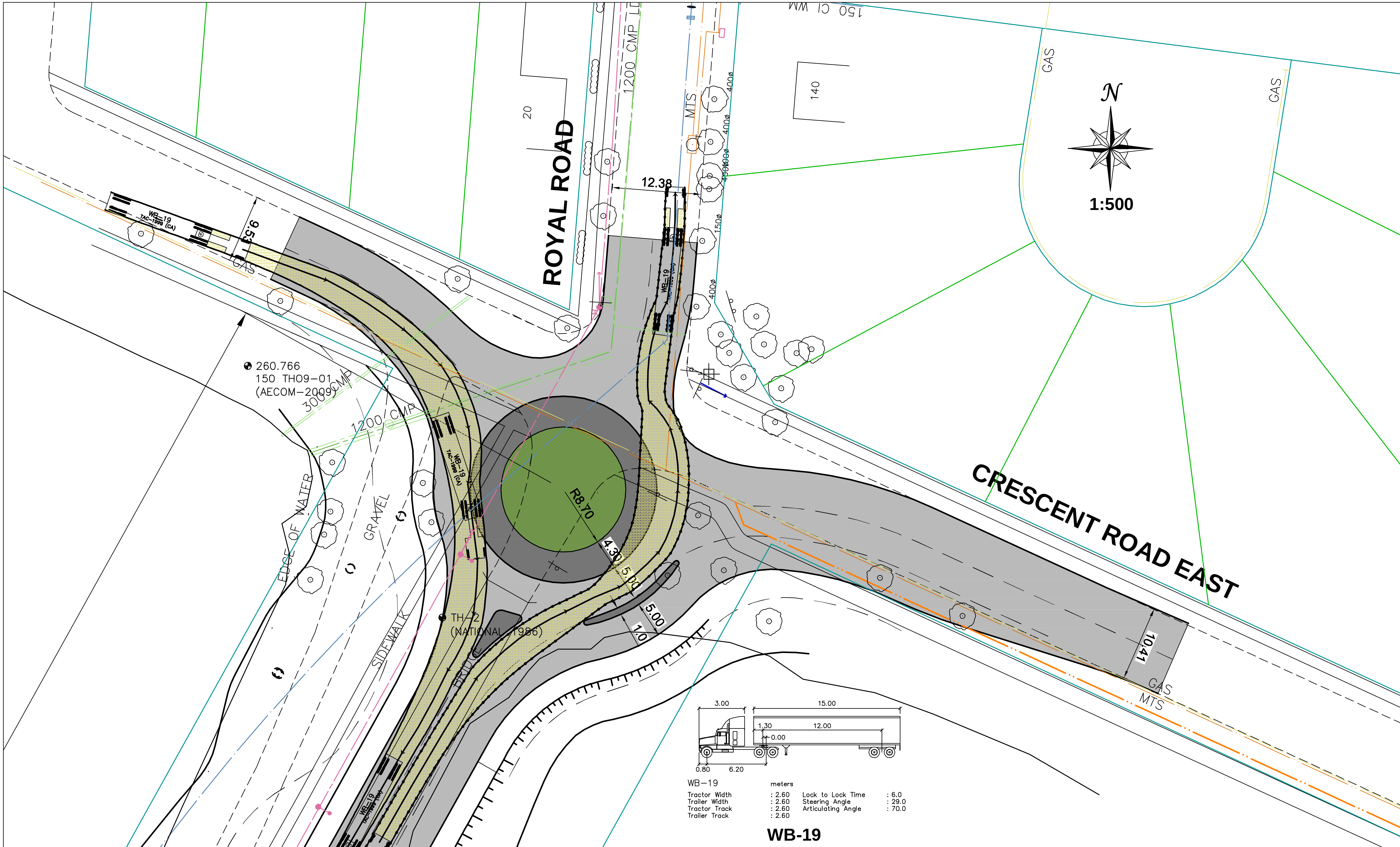
AECOM

B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 6/4/2015 9:52:27 AM Saved By: viergutzd

AECOM FILE NAME: AECOMv1-ANSI-FIG-BHL-M.dwt

ISS/REV:



TRUCK TURNING MOVEMENTS

FIGURE 5

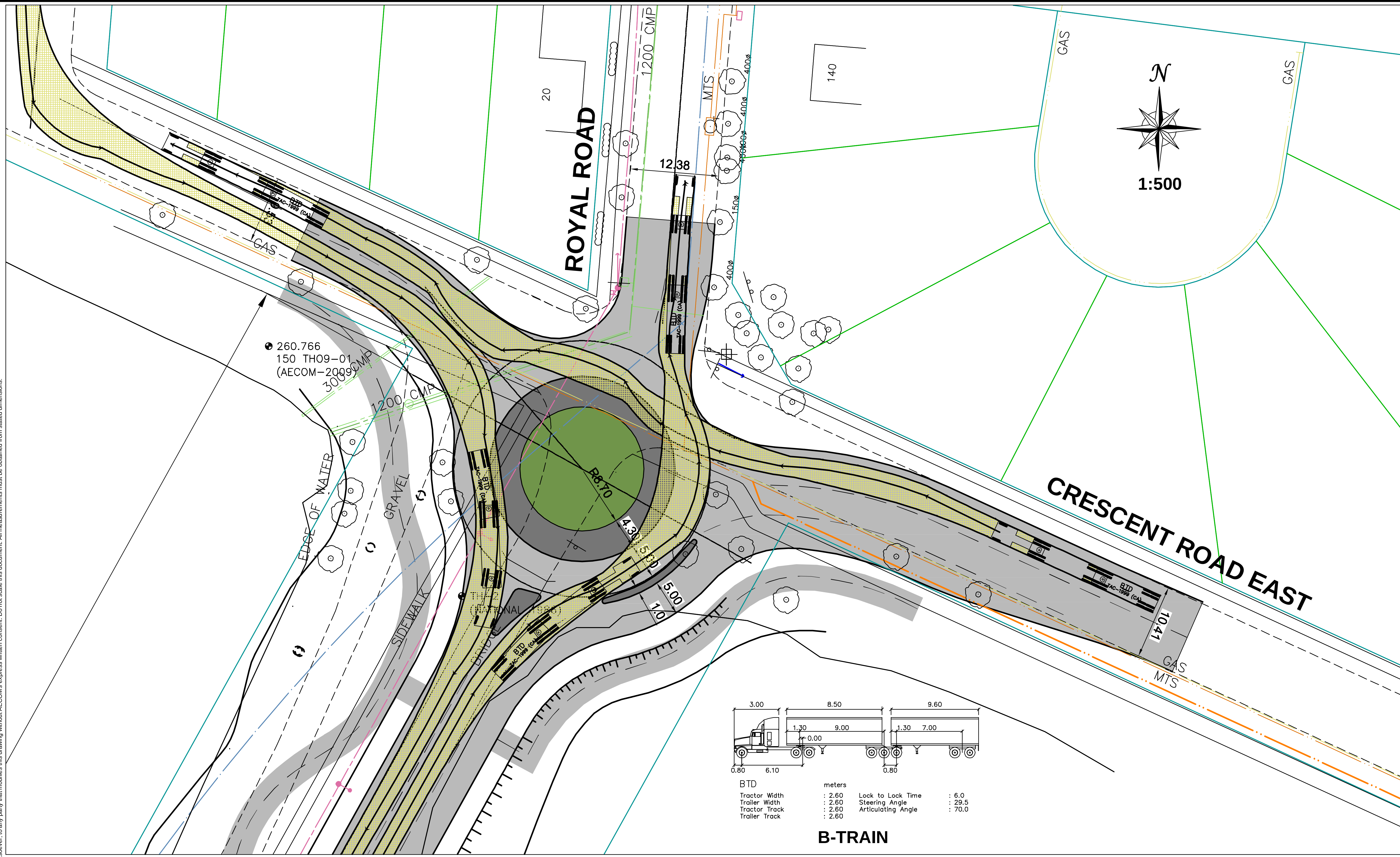
AECOM

B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 6/4/2015 9:37:03 AM   Saved By: viergutzd

AECOM FILE NAME: AECOMv1-ANSI-FIG-BHL-M.dwt

ISS/REV:



TRUCK TURNING MOVEMENTS
FIGURE 6